DOCUMENT RESUME

ED 346 830 IR 015 561

AUTHOR	Lofstrom, Mark D., Ed.; Wedemeyer, Dan J., Ed.
TITLE	Regional Interests and Global Issues: The Challenge of Telecommunications Integration for the Pacific. Proceedings of the Annual Conference of the Pacific Telecommunications Council (14th, Honolulu, Hawaii, January 12-15, 1992).
INSTITUTION	Pacific Telecommunications Council, Honolulu, HI.
PUB DATE	Jan 92
NOTE	1,419p.; For session summaries, see IR 015 562; for the 1991 proceedings, see ED 331 472.
PUB TYPE	Collected Works - Conference Proceedings (021)
EDRS PRICE	MF11/PC57 Plus Postage.
DESCRIPTORS	*Communications Satellites; Developing Nations; Distance Education; Foreign Countries; Futures (of Society); *Global Approach; *Information Networks; Information Systems; International Cooperation; International Organizations; Public Policy; *Regional Cooperation; *Telecommunications
IDENTIFIERS	*Pacific Region

ABSTRACT

This volume includes the papers presented at the 1992 conference of the Pacific Telecommunications Council (PTC), which focused on challenges of regional telecommunications integration. The more than 150 papers in this collection represent a wide range of interests, locales, and perspectives. Satellites were of special interest to discussions about regional integration of telecommunications in the Pacific, and many of the papers focus on the world's major communications satellite providers, innovative applications for satellite services, technical explanations of satellite capabilities, and proposals for new satellite networks. Attention is also directed toward mobile communications, which present numerous opportunities for augmenting many nations' limited telecommunications infrastructures and meeting new demands throughout the Pacific region. Policy considerations, the implications of regulatory frameworks, information networks and systems, observations on strategic alliances, and insights on investment and financing were also highlighted. Papers are indexed by paper number, subject, country, and author. Most provide their own abstracts and bibliographies. Thirty papers that arrived too late to be included in the bound proceedings volume have been appended to it. (DB)

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Proceedings

Pacific Telecommunications Council Fourteenth Annual Conference

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Edited by
Mark D. Lofstrom and Dan J. Wedemeyer

January 12–15, 1992
Sheraton Waikiki Hotel ▼ Honolulu, Hawaii

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Proceedings

Regional Interests and Global Issues: The Challenge of Telecommunications Integration for the Pacific

Edited by
Mark D. Lofstrom and Dan J. Wedemeyer

January 12–15, 1992
Sheraton Waikiki Hotel ▼ Honolulu, Hawaii

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Library of Congress Catalog No.: 91-068147

ISBN 1-8806-72-01

Published by
Pacific Telecommunications Council
2454 South Beretania Street, Suite 302
Honolulu, Hawaii 96822 USA

Printing sponsored by Northern Telecom

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THE PACIFIC TELECOMMUNICATIONS COUNCIL

PTC'92 is organized by the Pacific Telecommunications Council, and international non-governmental, non-profit organization. The council is regional in nature, embracing members from all the countries that play a role in the development of Pacific telecommunications. Its 319 members from Industry, Academia and Government are dedicated to promoting the understanding and beneficial use of telecommunications throughout the entire Pacific Hemisphere--North, Central, and South America, East, South and Southeast Asia, Australia, New Zealand, Melanesia, Micronesia and Polynesia.

Foreword

This volume includes the bulk of the papers presented at PTC '92, the 14th annual conference of the Pacific Telecommunications Council (PTC). The conference, entitled Regional Interests and Global Issues: The Challenge of Telecommunications Integration for the Pacific, focuses on challenges of regional integration.

PTC's annual conference provides information on current developments in the telecommunications sector and offers a neutral forum for the exchange of a wide range of viewpoints. Like the council itself, the authors whose papers are included in this volume represent a wide range of interests, locales, and perspectives.

While each year's conference is based upon a theme, inevitably the final content of the gathering also reflects the current concerns of telecommunications professionals throughout the region. This year's Proceedings illustrates that, once again, the annual conference serves as a spawning ground for ideas and promotes discussion about issues in the region.

Of special interest to discussions about regional integration of telecommunications in the Pacific are satellites. PTC '92 includes presentations concerning many of the world's major satellite providers, innovative applications for satellite services, technical explanations of satellite capabilities, and proposals for new satellite networks. Supplementing the focus on satellites is attention directed toward mobile communications. These technologies present numerous opportunities to augment many nations' limited telecommunications infrastructures and to meet new demand throughout the region.

Policy considerations, the implications of regulatory frameworks, observations on strategic alliances and the business dynamics of joint ventures, and insights on investment and financing are other concerns highlighted at PTC '92.

Of important note, PTC's entire series of annual conference Proceedings published since PTC '79 documents many developments in telecommunications and provides a time-series record of the evolving concerns in the ever-changing telecommunications industry.

The PTC '91 Proceedings featured, for the first time, a subject index. The concept has been refined for the PTC '92 Proceedings. First, through the creation of a supplemental index helpful in identifying papers that profile conditions or projects centrally tied to various countries and, secondly, through the addition of an index to authors, one can easily access single or multiple authored papers.

Due to a very tight production schedule, the papers are indexed by paper numbers, rather than by page numbers. Therefore, to facilitate expeditious location of materials, the indexes appear immediately following the table of contents.

An important feature of PTC '92, as at past annual conferences, has been the working groups included in the conference program. This year, the Proceedings includes background papers submitted in advance of the working groups. They appear following papers presented during regular conference sessions. Although the working groups background papers are included in the table of contents, they are not indexed with the regular session papers.

Mark D. Lofstrom
Dan J. Wedemeyer
Editors
Honolulu, 1992

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Sunday, January 12, 1992

Plenary

NOTES

Monday, January 13, 1992

Plenary

NOTES

Global Networks
The Challenge of Creating a Global Network

Hiroshi Ichihara
President
Kokusai Denshin Denwa Co., Ltd. (KDD)

Socioeconomic changes in the world make the countries in the world more and more interdependent on each other. Telecommunications are required to play a catalytic role to develop this trend further. KDD is making an effort to meet this requirement by offering to customers end-to-end services. This paper describes how KDD is aiming at achieving this objective.

1. Introduction

The changes taking place in today's world are truly revolutionary. The tearing down of the Berlin Wall was one of the most dramatic in a series of events that led to the easing of East-West tensions and political transformations whose repercussions will be felt for decades, if not centuries, to come. At the same time, the increasingly "borderless" activities of corporations everywhere have ushered in a new era of globalization and growing interdependence in every aspect of business and economics. As a consequence, we are witnessing an expansion in the scale and scope of human activity that is unprecedented in history. Inevitably, the spotlight is now on communications in the true sense of the word. This, in turn, is accentuating the importance of international telecommunications, which have always been the primary means by which people have communicated over international boundaries.

KDD's response to these dramatic events has been to initiate the development of a global network designed to provide end-to-end customer support. I would like now to take a closer look at some of the actual steps we are taking.

2. Streamlining the International Trunk Communications Network.

There are two types of international telecommunications networks, satellite and cable, but in my talk today I shall focus on the transpacific submarine cable network.

The bed of the Pacific Ocean already accommodates many submarine cables, as you can see from the first figure. Of these, optical fiber submarine cables have played a particularly significant role in handling the rapid increase in telecommunications traffic across the Pacific.

In April 1989, KDD and twenty-nine other telecommunications carriers from fifteen countries around the globe joined together to begin operating HAW-4/TPC-3, the first optical fiber transpacific submarine cable. On a 64 kbps conversion basis, its capacity is equivalent to 7,560 circuits, making it the core of the current transpacific network.

However, the rapid increase in the volume of telecommunications has made it necessary to construct a new cable, TPC-4, which is scheduled for completion in October 1992. This optical fiber submarine cable will also have a very large capacity: on a 64 kbps conversion basis, its capacity will be equivalent to 15,120 circuits. As I am sure you know, optical fiber submarine cables have higher quality and larger capacities than conventional coaxial cables, so they have become an indispensable means of meeting the rapidly growing demand for telecommunications capacity across the Pacific Ocean. Nevertheless, the astonishing increase in transpacific telecommunications traffic means that even when the new cable mentioned above comes into operation, there will not be sufficient capacity.

For this reason, plans for the construction of TPC-5CN are already well advanced. TPC-5CN will be constructed of high-volume optical fiber submarine cables providing, on a 64 kbps conversion basis, a capacity equivalent to 60,480 cir- cuits in a two-pair configuration connected in a loop. In fact, the TPC-5CN's design incorporates a revolutionary new concept - the self-healing system - which is illustrated in Figure 2. When a conventional submarine cable breaks down, we have to rely on satellite circuits or other cables for back-up until it is repaired. In contrast, each cable in TPC-5CN has its own independent back-up one on cable. By using two pairs for the circuits, the spare pair can take over for the first pair should it break down. Constructing the cables in a loop configuration allows transmissions to be switched to other cable on the loop should faults develop in both pairs.

Figure-1

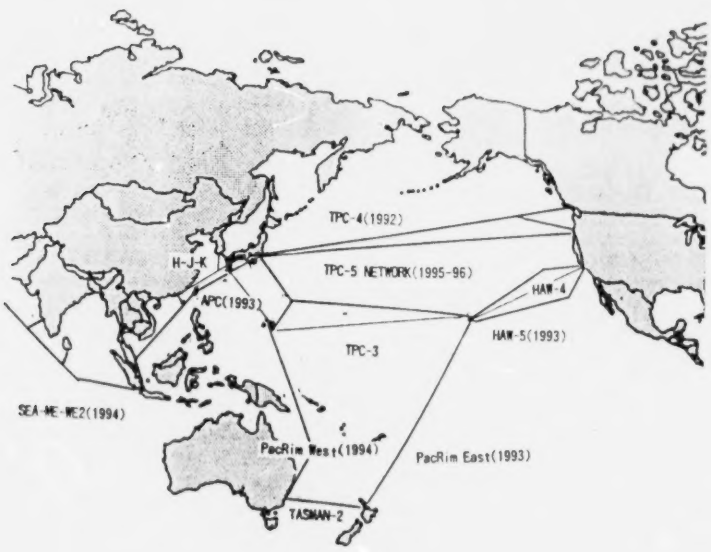
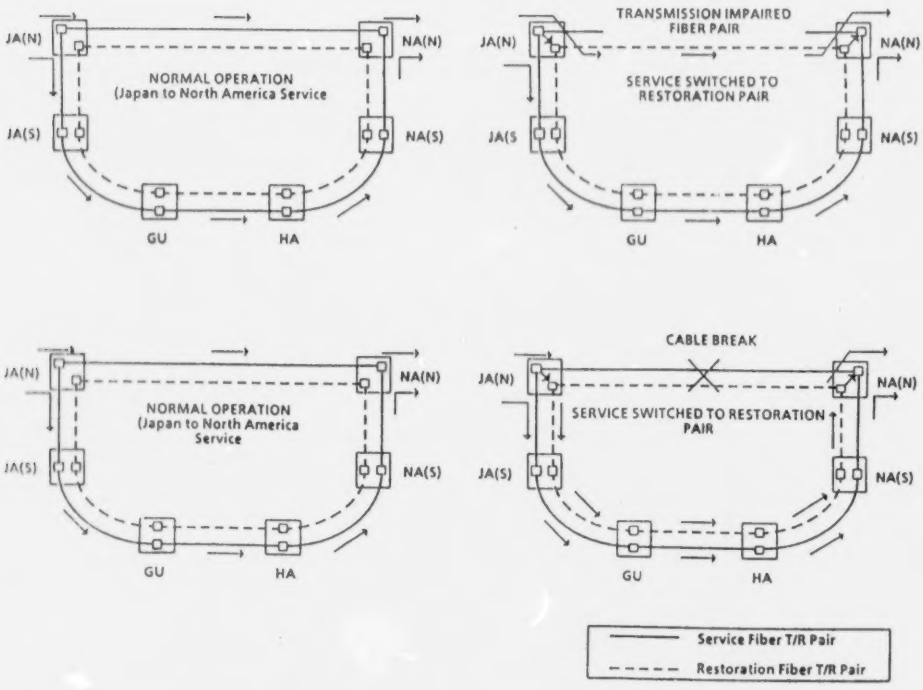


Figure-2

TRAFFIC DIVERSITY AND SELF-HEALING FIBER-ON-FIBER RESTORATION



Because the system permits instantaneous switching through the same transmission medium, it allows the provision of a secure and highly reliable network. Any future plans for laying optical fiber submarine cables are bound to place as much emphasis on security and reliability as on capacity.

Ordinarily, the optical signal transmitted inside the cable attenuates with the distance it travels, so that at set intervals it must be converted to an electric signal and regenerated. This requires submersible repeater. KDD has developed the technology to simplify repeaters in such a way that they amplify the attenuated optical signal as light without converting it to an electric signal. Because these simplified repeaters have fewer components, they are expected to provide greater reliability and allow larger signal volumes to be transmitted. Naturally these repeaters will be used in the TPC-5CN cable. More details of the new optical amplifier will be given at another session.

When, constructing an optical fiber submarine cable, it is important to increase the reliability of the cable itself, but more important is its maintenance; the maintenance system which enables rapid repair and quick restoration of the traffic when breakdown occurs. KDD is presently building a new cable ship, the KDD Ocean Link, which is scheduled in commission in February 1992, in addition to the KDD Maru which KDD presently uses for laying and maintaining submarine cables. She will carry the latest cable-laying equipment and a large-capacity cable tanks that will allow her to lay about 4,500 km of cable at one time. She will also be made highly maneuverable so as to facilitate the laying and repair of cable under the harsh ocean conditions of the North Pacific.

KDD has thus adopted an overall approach to building and improving the international trunk network which not only ensures that sufficient capacity is in place to handle telecommunications traffic, but also provides safer, more reliable circuits with an established maintenance system.

3. Improving the Domestic Telecommunications Network of the corresponding countries

When international telecommunications are seen as end-to-end services, it is obviously important to take the domestic network of the corresponding countries into consideration as well. The condition and status of domestic networks vary widely from country to country. In some countries, expanding or enhancing domestic networks to meet customer demand requires such vast sums of cost that a single enterprise cannot possible provide the finance. KDD is active here, too. As mentioned at PTC '91 last year, KDD, AT&T and the Ministry of Posts and Telecommunications of People's Republic of China are working together on the PRC Digital Network Project, for example.

International telecommunications between Japan and China are currently handled by an Intelsat satellite and by the Japan-China submarine cable. Demand for high-quality digital transmission is growing among the users in China, however, the cable is expected to reach full capacity by the mid 1990s. It is thus imperative that the domestic and international telecommunications networks be improved.

The PRC Digital Network Project was designed to meet this need. As illustrated in Figure 3, the first stage of the project calls for the use of local distribution radiowaves (LDRs) that employ digital microwaves to provide direct links between buildings in which customers are concentrated and an IBS urban gateway earth station installed on the roof of a Ministry of Posts and Telecommunications building. Digital leased circuit services will be provided via the Intelsat satellite over the Pacific Ocean.

This project will enable high-quality international digital transmission paths to be established via satellites in a short period of time. By redirecting international traffic that was previously handled on the domestic telecommunications network to these new links, the scheme will do much to reduce the burden on the domestic network. Services are expected to begin in the very near future.

As an extension of this project, the second phase calls for the construction of a Japan-China optical fiber submarine cable, which is scheduled to go into operation offering full-scale digital transmission services between Japan and China at the end of 1993.

While each country is basically responsible for building and enhancing its own domestic networks, one of KDD's goals is to contribute by making its technology available to countries that need it.

4. Services Provided with over the enhanced networks

Telecommunications services are faced with the task of satisfying a rapidly

diversifying range of customer needs. Simply providing transmission routes does not meet the demand for full end-to-end services. To cope with the situation, KDD has adopted a number of approaches, particularly with regard to corporate customers whose needs are especially diverse and sophisticated.

It is becoming increasingly clear that in order to operate in the borderless international market, today's businesses require high-capacity networks that provide real-time global links around the clock. At the same time, as they begin to use telecommunications in a more sophisticated manner, the construction of an efficient corporation network is an important part of any corporation's business strategy. As a result, corporations are not only demanding safer, more reliable networks, but are also moving toward integration of voice, images and data in a multi-media environment.

Another key trend in the creation of corporate telecommunications networks is "outsourcing." Corporations are finding it makes sense to concentrate on the areas of business where they are strongest, and entrust the implementation of networks and systems to the telecommunications providers who possess the necessary advanced technology and know-how. To meet this trend, KDD offers a line-up of the services called "KDD PLANS" which provide customers with comprehensive support for a wide range of networks, as shown in Figure 4.

As part of these services, KDD recently started offering the integrated network management service PLAN-M. Network monitoring equipment installed on KDD's premises provides total systems management and maintenance for customers, end-to-end, between Japan and abroad. PLAN-M deals with breakdowns speedily and makes it easier to control and analyze service quality. The SYSTEM-PLAN network service, on the other hand, lets customers use a system constructed on KDD's premises to build their own made-to-order system, while the PORT-PLAN network service provides a ready-made network by connecting the required customer cir-cuits to a system on KDD premises. As part of another service, PLAN-H, KDD provides space on its own premises for customers who want to build a network with their own telecommunications equipment, and monitors, operates and maintains the equipment on the customers' behalf. Finally, under PLAN-E, KDD makes use of its own expertise in a consulting engineering service to support customers designing their own networks.

By using these services, customers can create more sophisticated networks in shorter timeframes with greater safety. Combining the services increases the benefits of implementing networks that use integrated management, thus enabling KDD to provide finely honed services that meet customer requirements exactly. Many of KDD's customers are already enjoying the benefits of these enhanced services.

At the same time, KDD is introducing new features to meet demand for more sophisticated capabilities in public networks. Using the optical fiber submarine cables and digital satellite technology described earlier, KDD now offers international ISDN service to 11 countries, including the United States, Britain, France, Australia and Singapore, with service areas to be expanded in the future. KDD's next step will be the introduction of broadband ISDN service which should help satisfy the growth in demand expected to result from heavier traffic, such as in highquality audiovisual communications.

By providing an array of databases in the network, KDD can also provide services that offer higher added value. KDD already provides intelligent network services such as Auto-Credit Card Call and Free-Phone Service. Most recently, it has started providing international Virtual Private Network (VPN) services. These services allow customers to "tell" the network how they want to pay charges, dial destination numbers, and so on. Although these services are still at a rather primitive level, we consider them an important first step toward full-scale intelligent network services that include UPT service.

These endeavors are designed to transcend the ultimate dream of "face-to-face" telecommunications by providing tools that help people and implementing a global network that is intimately intertwined with human activities.

5. Global Carrier Cooperation

One critical factor in the programs and endeavors I have discussed to this point is the vital importance to the implementation of a global network of international cooperation and linkages between carriers. Obviously KDD cannot do it alone.

For international end-to-end telecommunications, the carriers in the originating and destination countries must work together. There are two possible types of carrier tie-up classified in line with the implementation of a global network. The

Figure-3

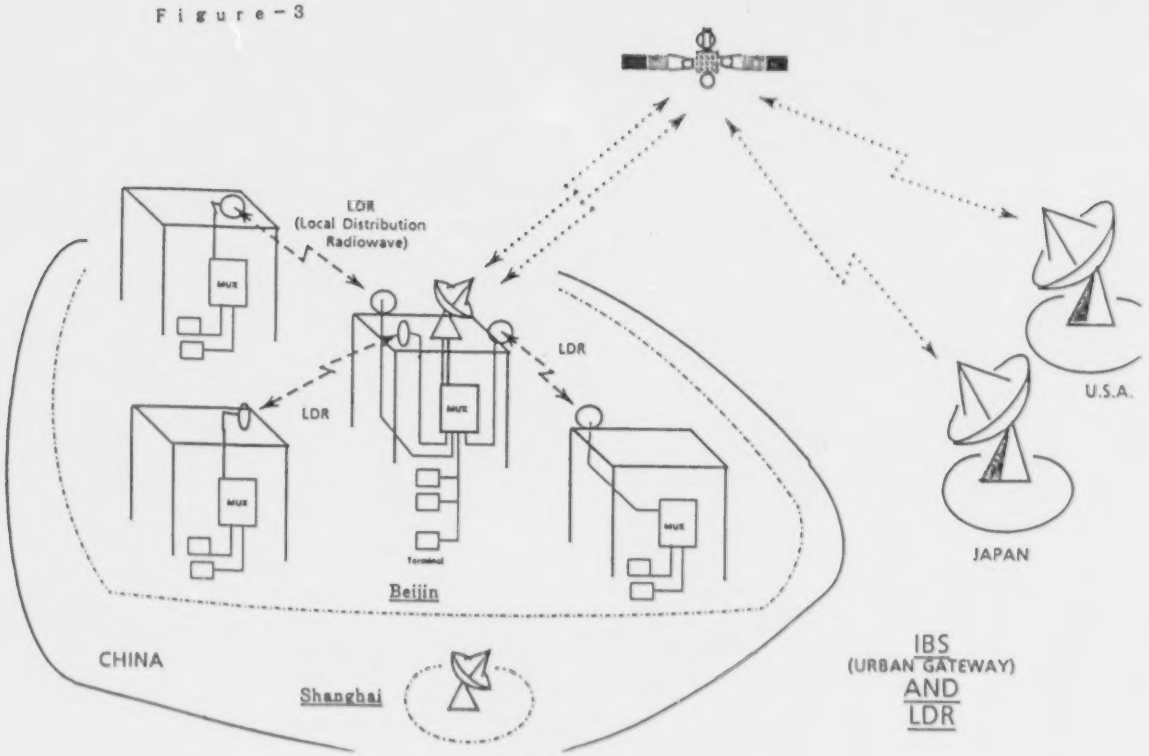
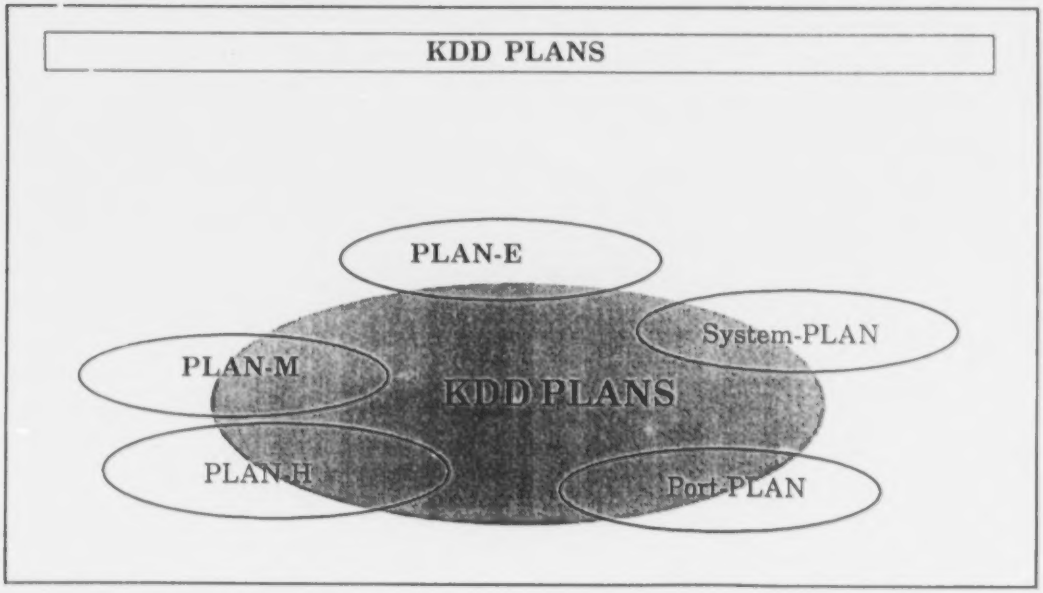


Figure-4



first is characterized by the construction of the trunk line networks themselves, such as optical fiber submarine cables, or the establishment of carrier tie-up in the implementation of ISDN. An example of the second is the provision of services by groups of multiple carriers under joint brand names. This has been a particularly promising method of expanding new services and is making a major contribution to the globalization of such new services.

One service that KDD offers using the latter format is "one-stop shopping," which enables customers to integrate any requirement to a single contact point of carriers within the framework of the international leased circuit service and many customers have made use of this service. One project has been recently started. This is a joint effort between certain carriers, including KDD, to set up an international telecommunications network that provides worldwide support to multinational corporations. Customers who wish to implement an international network employ those carriers to put together a lateral, joint project team that provides circuits, delivers, maintains and operates equipment, and manages the network. This system guarantees end-to-end telecommunications, integrates all points of contact when the network is set up, and delivers higher quality services with a shorter set-up time. Further joint projects with overseas carriers are also under consideration at KDD.

In addition to this type of tie-up, KDD works through the KDD Group's overseas subsidiaries, as illustrated in Figure 5, to provide end-to-end customer support in the form of consulting and other services.

In the context of implementing a global network, it is also vital not to overlook the importance of technical assistance to developing countries. Cooperation with developing countries is an essential element in the planning, creation and extension of the telecommunications infrastructure to ensure greater universality and compatibility in the sphere of international telecommunications. KDD has long been active in such assistance and will continue to work with developing nations to improve their international telecommunications.

6. Conclusion

To conclude, KDD is working toward the construction of a global network through the many projects in which it is involved. These include the building of a trunk line system for domestic and international communications that incorporates maintenance and operational functions, responding to corporate demand for more sophisticated services that utilize these networks, incorporating more intelligent features into a wider portion of the network itself, and working globally with other carriers on the development of the new technologies necessary for the proper implementation of these projects. In light of the revolutionary changes taking place in international society today, the provision of end-to-end services is vital to ensuring communications in the truest sense of the word. We look forward to facing these continuing challenges.

Figure－5

KDD GROUP COMPANIES ABROAD

AS OF OCTOBER 1991

NAME OF COMPANY	PRESIDENT	PLACE OF OPERATION	DATE OF ESTABLISH-MENT	CAPITAL	NUMBER OF EMPLOYEE	REVENUE IN YEAR ENDED MARCH 1991	CAPITAL CONTRIBUTION OF KDD
Telecomet International Inc. (TII)	N. OHYAMA	TOKYO, OSAKA, BEIJING	1984.11 1990. 5	¥1440M	200	¥6811M	KDD : 80% OTHER : 20%
Telecomet Inc.	A. YAMAMOTO	NEW YORK, LOS ANGELES, SFO, CGO	1981. 7	US$ 3M	124	US$10.7M	TII : 60% KDD AMERICA: 40%
Telecomet International Ltd.	A. SHIMIZU	LONDON	1984. 11	£400,000	26	£4.8M	TII : 75% KDD U.K. : 25%
Telecomet International GmbH	M. FURUYA	DUSSELDORF	1986. 1	DM800,000	10	DM 2.4M	
Telecomet International (S) Pte. Ltd.	H. DATE	SINGAPORE	1989. 12	Sin$ 300,000	5	Sin$ 800,000	TII : 100%
Telecomet International H.K. Ltd.	S. TOYODA	HONG KONG	1990. 4	HK$ 1.5M	4	HK$ 2.8M	

PRINCIPAL SERVICES OF TELECOMET GROUP: DEVLOPMENT, MANUFACTURING, SALE, MAINTENANCE AND CONSULTATION OF INFORMATION AND COMMUNICATION SYSTEMS

NAME OF COMPANY	PRESIDENT	PLACE OF OPERATION	DATE OF ESTABLISH-MENT	CAPITAL	NUMBER OF EMPLOYEE	REVENUE IN YEAR ENDED MARCH 1991	CAPITAL CONTRIBUTION OF KDD
Telehouse International Corporation of America	N. FUJI	NEW YORK	1987. 6	US$ 30M	52	US$ 4M	KDD : 25% NRI : 20% KAJIMA : 7% OTHER : 48%
Telehouse International Corporation of Europe Ltd	K. FUKUDA	LONDON	1988. 3	£15M	29	£3M	KDD : 33% NRI : 23% BT : 12% OTHER : 32%

PRINCIPAL SERVICES OF TELEHOUSE GROUP: PROVISION OF FLOOR SPACE TO ACCOMODATE COMPUTERS AND COMMUNICATIONS EQUIPMENT, 24-HOUR MAINTENANCE AND SECURE OPERATION SERVICE, AND CONSULTATION SERVICE ON PLANNING, IMPLEMENTATION AND MANAGEMENT OF COMPUTERS AND COMMUNICATION SYSTEMS.

Cooperation and Competition: The Role of Strategic Alliances in the Trend Towards Globalisation

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McKinsey & Company
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Globalisation and strategic alliances are the subject of much debate in the telecommunications industry. This paper explores the drivers and constraints of both subjects and outlines the impact that strategic alliances are likely to have on the trend towards globalisation.

Globalisation is the catchcry of the 1990s. It is a growing trend, especially in the area of telecommunications traffic carriage, which has prompted considerable debate within the telecommunications industry. Much of the debate centres around the emergence of strategic alliances involving domestic telecommunications companies (telcos) which have traditionally operated within a legislative framework that fosters cooperative agreements with other national telcos. Today, in the climate of globalisation and increasing competition, this is changing. Telcos are beginning to explore new ways of operating in their search for ways to gain the benefits of the globalisation trend.

Within the international arena, many telcos are behaving as if they believe that the current changes to the industry structure will lead to the emergence of a few truly global telcos. It is unclear, however, within the volatile industry structure whether any telcos have a clear recipe that will guarantee both the globalisation of the industry and their sustainable role within it.

This paper extends the current globalisation debate by bringing into focus the issues faced by strategic alliance participants, both prospective and established. It argues that success or failure in managing these issues will have a significant impact on the telcos' present vacillation between the old ways of cooperation and the new ways of competition.

To fully develop these arguments, this paper is structured around four themes. These are:

The traditional industry structure which forced cooperation between telcos

The impact of recent market developments, particularly the globalisation trend, on encouraging rivalry

The opportunities or constraints offered by strategic alliances within this framework

The winners and losers in the 'end game' of these developments.

1. HISTORIC TRADITION: FORCED COOPERATION

Many of the issues faced by telcos today—in particular, those surrounding the globalisation debate—stem from the traditional industry structure in which domestic monopolies operated within country boundaries and cooperated to provide international services. Understanding the drivers of this structure is important background to understanding today's instabilities and likely longer-term issues and outcomes.

1.1 NATIONAL PRIORITIES DICTATE DOMESTIC MONOPOLIES

Traditionally, the telecommunications industry has been characterised by high capital investments in basic domestic infrastructure offering long, and sometimes infinite, payback periods. Typical projects, such as developing the Customer Access Network, cost billions of dollars and provided returns over 20 to 30 years. To ensure these investments were made so that the entire population received telephone facilities, even in uneconomic cases, telcos developed as domestic monopolies in public ownership.

This not only provided government and regulatory support for the development of telecommunications, but also recognised that telecommunications was of national strategic importance and should be managed for the interests of the nation as a whole—not just for the profits of the telco. Only through these protected, monopolistic domestic industries could the multiple objective functions required for successful infrastructure development be managed. These objectives typically included providing telephone services at a loss to those who could not afford them and supporting the development of a local equipment supply industry. While many governments believe their telecommunications development has moved beyond this phase, we must recognise that some are still grappling with the problems of providing basic telecommunications to their populations.

This monopolistic approach suited isolated domestic markets where the government or regulator could provide stable operating conditions and could ensure a sufficient return on the high levels of investment involved. It was not suited to the international scene.

1.2 FORCED COOPERATION FOR INTERNATIONAL TRAFFIC

While investment in the development of international telecommunications was as large—and significantly more risky—as the domestic network, there was no 'global' government or regulator to manage development. Thus, development of international communications, particularly between continents, had to result from cooperation among the domestic carriers for international infrastructure development and traffic carriage.

This cooperation was formalised under long-standing bilateral agreements between telcos and, in some cases, nations. These agreements aimed to share the risks of major investment evenly among the telcos involved. They existed at many levels, for example:

Consortium of many telcos supporting the capital and operating costs of intercontinental satellite and fibre optic investments. The formation of the International Telecommunications Satellite Organisation (INTELSAT) in 1964 proved the high point of cooperation among telcos on this dimension. A multilateral body, INTELSAT aimed to administer and develop the emerging satellite communications infrastructure. Most governments throughout the world signed the agreement, considering such cooperation essential if the enormous investment in new satellite technology was to be achieved without undue risk being placed on individual carriers.

Revenue-sharing agreements for switched traffic carriage, whereby the originating carrier paid the terminating carrier a predetermined portion of the customer tariff–typically 50 percent in the early days. These long-standing agreements underlie the 'accounting rate system' as it is known today.

Split responsibilities for international private lines where each carrier took responsibility for billing and maintenance on their half of the circuit.

These agreements provided a stable, collaborative framework which supported the development of international infrastructure and services between national markets with monopolistic carriers.

2. MARKET DEVELOPMENTS: GLOBALISATION ENCOURAGES RIVALRY

The 1980s, however, witnessed several developments in telecommunications. Among these, it was the rapid decline in international infrastructure costs (particularly fibre optic cables) and the introduction of competition in national markets that placed the most strain on the collaborative industry structure.

Between 1983 and 1991 alone, the cost of installing transatlantic cable capacity fell from around US$1.5 million per Mbps to US$0.4 million per Mbps. Cultural and policy differences between countries resulted in differing lag times between the resulting decreases in transmission costs and decreases in the tariffs charged to consumers. This, combined with the rigidity of the accounting rate regime for switched traffic, meant the agreed outpayment to the terminating carrier began to act as a constraint on reducing consumer tariffs. These outpayments, which were frequently fixed for 5 years or more, rapidly became outdated as transmission prices plummeted. The result was the development of substantial traffic imbalances. For example, between 1978 and 1986, when US and German carriers paid each other on the basis of an accounting rate that remained fixed, US tariffs for carrying an 8-minute call fell from about US$17.50 to US$10.00, but German tariffs remained unchanged. Not surprisingly, this led to a substantial shift in traffic. By 1986, the volume of traffic from the US to Germany had increased to more than double the volume from Germany to the US.

These imba[illegible]ces, which affected the profitability of carriers and their host nation's current account, were exacerbated by the introduction of c[illegible]tition in the US, UK and Japanese markets in the early 1980s. Competition had two major impacts. First, with two or more carriers now bidding down each other's tariffs, the rigidity of the accounting rate regime became untenable. Second, telcos could consider operating in more than one domestic market. While historically regulation had limited their offshore activities to resale (where allowed) and the provision of value-added services, a selected few could now officially take advantage of the opportunities to provide basic services offshore.

The introduction of competition is seen in both developed and developing economies. The developed economies seized competition not only as an opportunity to take advantage of plunging technology costs and the rapid rate of new product innovations, but also as an opportunity to frighten their incumbent telcos, frequently regarded as inef[illegible]cient, into removing inefficiencies.

In contrast, developing economies, realising the importance of a reliable and technologically-advanced telecommunications network in building economic growth, are attempting major upgrades of their networks. Starved of cash to develop major infrastructure on their own, they look increasingly to foreign telcos and other investors to assume the responsibility and financial burden of developing their domestic networks.

Against these rapid changes within the industry, telcos and, in some cases, countries have exploited the inevitable restructuring and are operating in a global environment outside the jurisdiction of any truly international regulator.

The approaches taken to exploit these opportunities are increasingly diverse, but are limited in their effectiveness by a challenging set of constraints.

2.1 EXPLOITING OPPORTUNITIES

A combination of greed by telcos restricted domestically, fear by those threatened domestically, and obedience by those directed by some greater national priorities, has seen the emergence of two broad groups of international initiatives: those aimed at increasing domestic sources of telecommunications traffic and those aimed at supplementing domestic customer bases with offshore ones.

2.1.1 INCREASING DOMESTIC TRAFFIC SOURCES

Astute telcos, and in a few cases countries, have recognised the potential to shift international telecommunications traffic patterns and have exploited the limitation of the present industry structure to their advantage. With the apparently high price sensitivity, as shown earlier in the US/German example, securing pricing freedom by escaping the traditional industry structure can yield benefits to net exporters of traffic who will keep an unevenly large share of private lines and outgoing switched traffic and make no payment to the terminating carrier. Hence, the quest for increased origination of traffic.

Approaches to increase domestic traffic sources have been at three levels. At the first level, attempts were driven specifically by telcos seeking private network hubs but, as infrastructure costs continued to fall, these attempts were extended to the second level, which involved undermining the broader bilateral agreements governing international switched traffic carriage. A third and complicating level has been the broader initiatives by countries which want to pursue commercial hubs. The three levels are discussed in more detail below.

Seeking private network hubs

The traditional way to capture international traffic revenues is through hubbing of private networks. Since each telco is paid for its half of an international private line, the one which can attract a hub gets many half circuits worth of revenue, while the telcos at the end of the spokes only get one each. Pricing and service are the primary levers used to influence a corporate's choice of hub.

Pricing is a straightforward and easily understood initiative. The service initiatives provided the start of 'one-stop shopping'—trying to overcome the need for a customer to deal with two telcos, one domestic and one offshore, to establish and operate a private line. Agency agreements provided early mechanisms to achieve this aim, but have rapidly been replaced by joint service and marketing agreements among telcos.

The recent emergence of Virtual Private Networks (VPNs) also affects the telcos' ability to provide 'one-stop shopping' internationally—in this case, by providing pseudo-private networks over an intelligent switched network.

Undermining bilateral arrangements

Due to infrastructure price reductions, large international telcos are capable for the first time of developing 'private' international capacity. This has led to the development, by a small number of essentially private consortia, of projects such as the private transatlantic satellites and cables. These developments—although perceived as risky—are positioned to have substantial long-term impact on the business if they are managed adeptly.

Telcos with private infrastructure and operating licences or agreements in multiple domestic markets will be able to sidestep the accounting rate regime—international traffic carriage between their markets effectively becomes an internal transaction. Even if accounting rates are technically applicable, it becomes nothing more than an internal transfer price that is irrelevant to the overall economics of the business. Telcos acting in this way will have greater freedom to exploit price elasticities and increase traffic origination through lower end-to-end call prices. Telcos that do not have this capability will remain bound by accounting rates and will be unable to respond without either reducing accounting rates to zero (a tough challenge) or incurring significant losses.

In addition, by driving tariffs down on thick routes, telcos with private infrastructure remove the scope for the current cross-subsidy from profitable thick routes to unprofitable thin ones. In the extreme, this could drive the INTELSAT consortium described earlier to become a form of global Universal Service Obligation. Nations with telcos too small to build their own international network would continue to rely on the system while the larger, richer telcos would build their own capacity and withdraw equity from the system. A possible end result is that INTELSAT will become a collective of poor nations and national telcos, unable to fund itself and unable to support the investment needed to maintain a serviceable infrastructure.

Pursuing commercial hubbing opportunities

Throughout the last decade, transnational corporations (TNCs) have expanded their operations through the development of global and regional headquarters (RHQs). Several countries are competing to attract TNCs and their RHQs in a bid to develop the pre-eminent regional commercial hub. This has moved well beyond private line hubbing as telcos and, increasingly, governments realise the significant benefits—in terms of employment, investment and the further development of a host services sector—which flow into the country if it is a favoured location for an RHQ. For example, it is estimated that the City of London, which has a hub based around financial services, employs 357,000 people and contributes over £20 billion to Britain's Gross Domestic Product.

Most Asia-Pacific governments have taken initiatives to position themselves as the natural choice for an Asia-Pacific RHQ. Singapore, in particular, has been pursuing TNCs through its Operational Headquarters Program, and through close cooperation between the Singapore Economic Development Board and Singapore Telecom. The city now promotes itself as a 'total business centre' and is careful to ensure that the cost and quality of its telecommunications services are attractive to TNCs.

While the cost and quality of telecommunications services are important characteristics which TNCs look for when deciding on where to base their RHQs, they also look for a number of other factors. These include: political and economic stability; quality of life; reliability, cost and skills of the local work force; extent of deregulation and/or bureaucracy and government incentives.

2.1.2 SEEKING OFFSHORE CUSTOMER BASES

Telcos that have taken advantage of every opportunity to increase domestic traffic sources may then turn to offshore customer bases as a source of additional revenue and profit. These telcos are motivated by a number of imperatives, including the desire to follow domestic corporates, the need to replace customers lost through competition and in response to supply chain pressures.

Following corporates

One natural source of offshore customer bases is the offshore arms of domestic corporations. As in many other businesses, either network or product, following captive domestic customers as they venture in foreign markets is a low-risk entry vehicle. The increasing propensity to outsource global networks and the much discussed trend of 'one-stop shopping' are no doubt adding momentum to this trend. For the US, Japan and UK (and possibly Germany and France), the nations which are home to the majority of the world's TNCs, this may well have potential as a sustainable vehicle.

Yet, looking beyond the euphoria-at the increasingly large effort and capital committed to these global network initiatives (VPNs, acquisition of data networks, private cable networks, joint marketing initiatives) and, at the end of the day, the relative sophistication of the target customers-we must question whether this is a viable long-term strategy for even the top telcos, let alone the 'also rans'. Will this be the rapid globalisation and shake-out of corporate banking revisited?

Replacing customers lost through competition

Telcos threatened by the introduction of competition into their previously cosy domestic markets know the experience is painful. With increasing focus and speed, the new entrants are relieving the incumbents of significant market share and, through targeted marketing, an even greater share of industry profits. Falling cash flows, competition for skilled resources and burdens inherited from the monopoly days require drastic action. Domestic efficiency and market stimulation programs help, but not to the extent needed to overcome the damage of a skilled entrant, or entrants. Devices like Least Cost Routers simply exacerbate the situation. One clear response to these pressures is to seek new offshore customer bases, which telcos hope will create scope for future growth, provide opportunities for retaliation and raise the potential for bypassing the constraints of the traditional industry structure. With the introduction of competition in developed and developing markets, the motivation and opportunities for this behaviour are increasing.

Spending cash reserves

While seeking offshore customer bases in response to domestic competition is an honest motivation, it is not the only one. Domestic regulation has left many of the world's significant telcos (such as the Regional Bell Operating Companies in the US) with significant, protected cash flows and, up until recently, limited outlets to spend domestically. There is only so much capital you can plough back into upgrading a network. What else is there to do but seek out offshore investments?

Regulations are shifting to lower these cash mountains but, while such protected 'rich kids' exist, the prime opportunities will be in high demand. This may or may not lead to premiums being paid, but it will lead to more rapid damage in deregulated markets by cash-rich attackers still protected by monopolies back home.

Responding to supply chain pressures

Concentration in the telecommunications equipment and application services industries may also contribute to the drive for offshore investment by carriers. Over the last 5 years, worldwide overcapacity, increasing expense of research and development, and the decline in industry profitability have contributed to a concentration among the major equipment suppliers. Alliances and common user group demands have also accelerated the concentration of application service providers, both in national markets and internationally. At the same time, the traditional dominance of national markets by monopoly telcos is eroding as competition is introduced. The equipment suppliers and application service providers are, hence, gaining increased bargaining power. Inevitably, as this value transfer swings away from the carriers providing the infrastructure, carriers will be forced to multi-domestic investment if they are to build the scale needed to contain or reverse the value transfer.

2.. OVERCOMING CONSTRAINTS

With all these opportunities, why don't we already have a global industry structure? These opportunities are appealing and, no doubt, frequently articulated around the boardrooms of telcos internationally. But a number of major hurdles must be overcome before any telco can exploit them successfully. Key among these hurdles are choosing the appropriate opportunities, persuading the stakeholders that returns outweigh the risks, and winning the battle for resources.

Choosing the appropriate opportunities from the myriad available is the first challenge. On one hand, this means making decisions about the type of opportunity. Should a telco participate in privatisation of an existing carrier, buy an operating licence, invest in a 'build, own and operate' scheme in a developing country, buy an existing private network or public value-added network or invest in private domestic infrastructure? What about some combination? Or should a telco acquire a telecommunications-related business (for example, a hardware or software provider) or build a reputation through project management or consulting? Estimates suggest privatisations alone will consume over US$400 billion over the next 5 years. On the other hand, it means making decisions about the type of technology. Should a network investment be in radio, mobile or fixed network technology? Further complications arise when the use of bidding partners or consortia are concerned. Are they necessary? What will they bring? Can they be trusted? How should the deal be structured?

Simply sifting through deals and investment strategies presented by the hardware manufacturers, banks and other interested parties, is a daunting task that confuses and intimidates many prospective entrants-and that is not where the real action is. Leading telcos are creating the most attractive deals, many of which require significant change to regulatory frameworks. Much like the commercial real estate industry-the deals ending in the public arena have already been well screened and rejected by the leading players.

It is easy to see how many telcos have trouble getting out of the starting gates.

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Persuading the stakeholders, including senior management, the board of directors and the government, that returns outweigh the investment and risks is the second challenge. Many of these stakeholders have little or no international experience and they need reassurance that the risks, ranging from political and economic stability to physical work conditions, can be managed. Stakeholders have every right to be nervous, given the high capital and long payback periods in many of these investments–particularly for fixed networks and for privatisations. Some members of senior management may even simulate strong resistance–despite intellectual commitment–if the need arises to divert funds away from their own domestic investment programs.

Winning the battle for resources is the third challenge. This is tied up with the organisational quest for control, which is no doubt familiar to many of you: a separate international division or global business units? With an international investment division, at least initially, domestic business units have little incentive to free scarce resources for offshore ventures. In contrast, global business units are complex to control and can lead to multiple uncoordinated activities in a given region or country. Again, while intellectually the solution may be clear, the resistance to implementing it–particularly by a territorial management team–may be immense.

These constraints are not unique to telcos, but are exacerbated by the government and regulatory intervention experienced in telecommunications. Neither do they preclude action. They simply raise the entry barriers–potentially to where a crisis is necessary to overcome the 'domestic myopia' of telcos and their stakeholders.

3. STRATEGIC ALLIANCES: OPPORTUNITY OR CONSTRAINT

As we have seen, the continued introduction of competition in domestic markets, combined with rapid decline in international infrastructure costs, destabilises the industry and results in a shift in focus from domestic operations, through a transitory phase of 'domestic with an international flavour', to longer-term questions over the emergence of a global industry.

As this occurs, the industry structure and the rational behaviour of major participants within the industry structure is also undergoing major change. Traditional alliance behaviour, aimed at short-term reduction of risk and sharing of investment costs, has less relevance and existing relationships may become uncertain. Forward-thinking telcos can exploit this instability by becoming a part of, or forming, a 'new game' global alliance positioned to have a formative impact on the emerging industry structure and become a major participant in the global industry. In the extreme, this would lead to the vision of a 'Borderless World' (as outlined by Ken Ohmae, Chairman of McKinsey & Company, Japan) being realised in telecommunications. The current telecommunications concept of cities and countries separated by major distances would collapse, and cities and countries would all be seen as adjacent local call areas (a view published by Clem Doherty, a Director in the Australian office of McKinsey & Company and co-leader of our Asia-Pacific Telecommunications, Electronics and Media Practice).

There is, however, little evidence of successful alliances of this nature in the telecommunications industry, where alliances have played more specific roles and wrestled against many unique challenges.

3.1 ROLE OF ALLIANCES

Given the range and scope of international activity, and an equivalent range and scope of themes in alliances, it is not surprising to see that the end result is a complex patchwork of alliances and joint ventures, with emphasis on short-term issues. Few of these alliances have been used as vehicles to pursue multiple opportunities and even fewer could be considered a startling success–particularly on the scale needed to make a fundamental impact on the development of the industry.

Under the traditional industry structure, early alliances formed between telcos, and in some cases between telcos and equipment manufacturers, include:

Cooperation and equity agreements to build international capacity through undersea cable or satellites such as the original Trans-Atlantic Cables and the INTELSAT satellite consortium.

Cooperative bilateral agreements covering international traffic carriage and billing arrangements through the accounting rate regime.

Memoranda of Understanding for limited personnel and technology exchange.

Joint agreements on short-term, project based, research and development.

Long-term operating contracts between telcos and equipment suppliers to provide installation, maintenance and upgrade of equipment domestically.

These types of alliances are still being pursued in areas such as international cable and satellite investments, but forces are emerging in the industry structure to reduce their effectiveness.

More recently, alliances have been used to describe cooperation and operating agreements such as:

Consortia of telcos and local partners bidding for major foreign licence opportunities such as the Optus consortium, consisting of Cable & Wireless (C&W), BellSouth and local Australian partners AMP (an insurance company) and Mayne Nickless (a transport company), which has recently been awarded the second Australian licence.

Consortia of telcos, equipment manufacturers and local partners bidding for foreign mobile licence opportunities, such as the Unitel consortium, consisting of STC, US West, Thorn EMI, and Deutsche Telekom, which was awarded a PCN licence in the UK.

Consortia of telcos, equipment manufacturers and even large user groups, which developed alternatives to the 'official' international cables for semi-private use. For example, the consortium of C&W, C.Itoh, Toyota, Pacific Telesis, Merrill Lynch, Singapore Telecom and US Sprint, which developed the ASPAC cable linking Japan, Hong Kong and Singapore.

Consortia established to target foreign market niches, such as the AT&T, Hutchison Telecom consortium targeting Value-Added Network services in Hong Kong.

All of these, however, could only loosely be termed strategic alliances. As some combination of joint ventures, acquisitions and long-term contractual relationships, they are not genuinely strategic alliances. Ken Ohmae, in his book, 'The Borderless World', describes a true strategic alliance using the French word 'entente'–a friendly understanding between major powers. It is most typically used by leaders of nations operating towards a common cause–and leaders of nations rarely use joint ventures, acquisitions or long-term contractual relationships to formalise their understanding.

This is an important distinction and one we will return to as telcos' ability to achieve it, we believe, will be a major determinant of at least the speed and possibly the overall emergence of a global industry structure.

Before moving to this broader goal, however, we must step back and address the real constraints which face the current alliance activity.

3.2 CHALLENGES FACING ALLIANCES

Alliances between networked business pose inherent difficulties and telecommunications is no exception. Not only must telcos confront the traditional challenges which face alliances, but they must also face the specific challenges of being in a networked business.

3.2.1 TRADITIONAL ALLIANCE CHALLENGES

As a starting point, establishing and managing an alliance for the long-term benefit of both partners requires that the alliance be designed to meet specific strategic objectives and to incorporate structurally key elements that encourage flexibility, participation and commitment by both partners. Our principles for successful alliance design, and hence the challenges faced by any telco entering an alliance, are as follows:

Strategic objective. The form of the alliance, the chosen partner, the agreed ownership structure and the scope of alliance activity must be designed to meet the strategic objectives of each partner.

Mutual dependence. The alliance must become a critical part of the overall strategy for each parent, such that the partners have the utmost incentive to provide the commitment and resources required to make the alliance successful.

Alliance independence. The alliance must be of substantial size and be given sufficient scope to allow it to reach the critical mass necessary to develop 'a life of its own' and the ability to sustain itself without excessive reliance on the parents.

Capability to evolve. Mechanisms must be in place that either allow or enforce the parents to adapt the strategy and structure of the alliance to changes in the competitive environment.

Barriers to exit. Structural or operational barriers to exit that make it difficult or painful for any of the partners to walk away and establish an independent business also need to be in place.

Shared vision and rewards. Mechanisms that allow and encourage partners to develop a common vision for the alliance and share in the rewards and benefits of working together, regardless of the success of a specific venture, should also be in place.

Clearly, a challenging agenda and one containing many inherent conflicts. Careful design of the alliance and ongoing management of the tensions is not a trivial task–it takes valuable time and resources.

3.2.2 ADDITIONAL TELECOMMUNICATIONS-SPECIFIC CHALLENGES

If the challenges which face traditional alliances are not difficult enough, the trade-offs between shareholder and stakeholder motivations, the complexities in network businesses and the ease with which services can be replicated complicate alliances in the telecommunications industry even further.

Shareholder versus stakeholder

Alliances will be tested by the different objective functions of telcos. While a few telcos have now been partly or fully privatised, with their sole target being shareholder wealth, the majority are still government-owned and/or regulated and have much more complex objective functions. These objective functions include wealth creation, but also cover other burdens such as universal service provision, even if many of those services make a loss, and supporting domestic supply industries. These differing objective functions complicate the determination of an ownership structure and scope for the alliance that meets the objectives of both partners.

Complexity in a network business

As international alliance activity grows increasingly complex, the number and scope of the cross-interests rise. In a stable operating environment, such activity may well be sustainable. Internationally, however, as the pendulum swings from the cooperate to compete axis these cross-holdings become unstable. This instability is caused by a number of factors.

Self interest of telcos that can only follow their major corporate customers across borders so far without moving into other alliance partners' markets.

Self interest in alliances between equipment manufacturers and telcos where motivation and objectives are very different. The equipment manufacturers are motivated primarily by up-front equipment sales, while the telcos are motivated by ongoing network development and usage.

Increased competition in domestic markets increases telcos' desire to divert their domestic competitor by using the 'my enemy's enemy is my friend' dynamic. The potential effect of this on the complex international alliance relationships could be to destabilise the entire structure.

Instability in the current international alliance structure will result in a reduction in the effectiveness of existing relationships. It will potentially force telcos either to 'go it alone' or to form strictly-aligned major groups which would have the ability, through long-term relationships, to take advantage and influence the direction of the global industry structure.

Alliances advantages shortlived

In many industries, alliances can create advantage for their participants for many years-even though they are unlikely to last forever. This is not always the case in the complex networked business of telecommunications.

The current crop of global VPNs provide a good example. While the first of these was heralded as a world initiative capable of revolutionising the industry for those involved, it soon became clear that they could be copied. less than 2 years later, there are now multiple alliances, all involving multiple carriers and all offering similar services. None could be described as carving out a valuable and sustainable niche position and, more importantly for this discussion, as regulation changes none of them really need consortia to be effective.

End-to-end ownership of international infrastructure was similarly heralded as an industry restructuring initiative but has now become commonplace-all in the space of 4 or 5 years.

4. END GAME: LIKELY DETERMINANTS

As in any industry, the end game is tough to predict and is unlikely to be either black or white. Key issues, like the emergence of supranational regulators or the success of truly strategic alliances, will be the determinants of the timing and nature of globalisation within telecommunications. At the top level, we can foresee two extremes of possible outcomes.

An oligopoly of global telcos emerges as successful alliances create true strategic advantage for a select group of competitors, supranational regulators fail to emerge, and a series of cross-border moves, mergers and acquisitions occur.

Concentration of significant cross-border holdings in the hands of a few major telcos does not eventuate. Competition continues to be introduced in domestic markets, but regional and supranational regulators of carriers, combined with continued failure of alliances, prevent the formation of an oligopoly of global telcos. Infrastructure and arrangements for the carriage of international traffic will continue to be handled through multilateral agencies like INTELSAT and by cooperation between telcos.

The end game, however, is likely to be somewhere between the two extremes and dictated to some degree by the regional regulators already in place. If we think about regionalisation, and then globalisation, the determinants become clearer.

4.1 REGIONAL OUTCOMES

Regional outcomes, under the influence of very different regulatory forces, are likely to be distinctly different from global outcomes in both their process and end point.

A slow but managed transition is likely in Europe. Due to its geographic concentration and the harmonisation achieved through the European Community's 1992 initiative, Europe shows little potential to be anything but an orderly managed transition towards regionalisation in telecommunications. Eastern Europe may create a few ripples, but little more. The uncertainty in Europe is how fast the regionalisation will occur, particularly given the diversity of starting points of the member nations and how far the regulations will ultimately allow competition to spread.

A faster but still managed transition is likely in North America. North America will remain under the strict control of the FCC and amendments to the Modified Final Judgment governing the activities of telcos-albeit with a greater tendency towards litigation than in Europe. Having been through the first phase of regionalisation in long-distance traffic carriage, the impending deregulation of the Regional Holding Company monopolies will cause pockets of angst, but is unlikely to be allowed to degenerate to mayhem.

A managed transition is well underway in Japan. Many would suggest that Japan is not a region but it is of such significance, economically and geographically, that it justifies separate consideration. Japan's transition has been rapid but relatively ordered. In this case, rather than a single 'official' as in Europe or North America, the complex web of control under the Keiretsu and government intervention in managing the telecommunications industry will prevent major disruption. NTT and KDD may argue, but the introduction of competition, despite the major impact on the incumbents, has been orderly.

A messy, unmanaged transition is likely in the rest of the Asia-Pacific region, if regionalisation actually eventuates. The wide disparity in political and economic objectives, different stages of economic development and relative geographic isolation combine with the lack of any form of regional regulation or control to make development in the region highly unpredictable. More than anywhere else, the eventual outcome will be dictated by truly competitive forces-both at a telecommunications industry and national level.

4.2 GLOBAL OUTCOMES

The differences in regionalisation approaches and timing outlined above do not form an easy foundation for predicting the likely global outcome.

Alliances will be one of the key factors in determining the industry structure within these regions, particularly within the Asia-Pacific,and in linking regional activities together if an oligopoly of global telcos is to emerge. We have already seen that alliances are more troublesome to manage in the telecommunications industry than in any other industry and that their benefits are likely to be shortlived. Yet, to ensure globalisation,

alliances will need to be used to produce industry changes on a scale not yet witnessed. These changes include:

Changing the rules of international traffic carriage by cooperating across a wide range of international traffic routes to bypass the traditional industry structure and destroy the economics of telcos without end-to-end interconnectivity.

Sharing research and development efforts between telcos to develop the ability to implement proprietary, world leading network applications quickly.

Using international alliance activity to curtail the effects of competition in participant's home markets, through using dynamics like 'my enemy's enemy is my friend'. This is both key to securing domestic cash sources and possible given the lack of any single global regulator.

Gaining access to third-party markets by leveraging the combined resources of alliances and promising global connectivity, and increasing domestic traffic flows for the new market as a result.

Achieving these outcomes within strictly aligned alliance groups that do not lead to alliance partners cooperating in some markets while competing in others.

If these can be achieved, which is theoretically possible although unlikely in practice, globalisation of the industry will come a step closer. It is not, however, guaranteed. At least two other events could prevent its realisation.

First, a supranational regulatory body could emerge to block the development of global telcos. This is not an unreasonable outcome given the impact that an oligopoly of global telcos could have on the global industry structure and hence the damage they could do to the interests of the many smaller, less financially secure telecommunications economies.

Second, selected countries, particularly in the Asia-Pacific region, could act unilaterally to undermine globalisation. For example, a country could choose to offer free international calls. Clearly this could only be done through government ownership as it would mean major losses for the telco. A far-sighted government, however, may see how the telco's losses could be more than offset by benefits realised elsewhere in the economy. Imagine the boost it would give to the local business community, particularly value-added service providers, and to the ability to attract corporate RHQs. The flow through benefits to the government of increased business activity (e.g. employment, taxes) could be immense.

This is an unlikely outcome, perhaps, but if it happens it will bring chaos into the industry as newly-corporatised telcos will be unable to respond.

(1) Contributions from Paul Twomey, Adam Lewis and Shinji Yamamoto-members of McKinsey & Company's Telecommunications, Electronics and Media Practice-gratefully acknowledged.

Joint Venture or BOT: The Choice for Telecommunications Development with Foreign Involvement

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1. ABSTRACT

Privatization of telecommunications is following varying evolutionary paths in different countries leading to a whole range of industry structures. The objectives of Privatization are identified and the way in which the varying structure meet these in the short and long term is summarized in a checklist.

2. THE FIRST STEPS TOWARDS PRIVATIZATION

In the past four or five years, what is accepted as the telecommunications regulatory norm has changed dramatically. Prior to that most countries had either a ministry department monopoly or, increasingly, a state-owned corporation formed from the ministry department. Already the first steps towards widespread privatization had been taken. UK and Japan had introduced rapid changes bringing in both private investment and competition. Several territories had enjoyed the fruits of private enterprise in telecommunications for many years of course - amongst these in the Asia Pacific Region were USA, Hong Kong, Fiji, Philippines, Bahrain, Yemen Arab Republic and Guam, joined more recently by Macau, Tonga, Solomons, Vanuatu , PRC and others. Not surprisingly the acceleration of this trend recently has produced divergent formulae which will not all meet the high expectations of customers and governments alike. Where have these formulae come from, how do they compare and which will attract the ongoing investment essential in the industry? This paper tries to answer some of these questions and identify solutions which work if the political will exists.

3. PRIVATIZATION

3.1 COMMON THEME

A common theme is apparent in the telecommunications service industry of some of the most advanced industrialized countries, newly industrialized countries (NIC's), developing countries heading that way and several of the Communist and recently Communist countries now emerging into the World Economy. That theme is privatization.

3.2 FORMS OF PRIVATIZATION

Privatization is taking one of a number of forms; some possible because of the large and sophisticated market for the services while others are dictated by restricted availability of resources or political and economic constraints. The traditional view that telecommunications cannot be entrusted to the private sector, and far less the foreign investor, is being challenged in many developing and industrialized countries alike.

The importance of a good telephone service to economic growth in developing countries is becoming part of accepted wisdom by politicians and bureaucrats alike. Recent research (Table 1) has demonstrated a remarkable correlation between economic growth and improved telecommunications adding to the evidence from the growing number of countries which have taken the plunge. That ultimate step to full private sector and foreign participation still eludes many Governments, giving rise to a wide range of structures all aimed at the same ultimate goal - accelerated improvement in the quality and quantity of telecommunications service available.

The structures considered in this paper are:

- Fully Privatized Operation (BOO)
- Franchised/Licensed Joint Venture (JV)
- Build, Operate and Transfer (BOT)
- Build, Transfer and Operate (BTO)

and an attempt is made to compare the implications of these for the country as a whole and the investor.

TABLE 1 PER CAPITA GNP AND TELEPHONE DENSITY
OF VARIOUS COUNTRIES
1987

Country	Per Capita GNP ($)	Telephone Density (Main Lines per 100 inhabitants)
Switzerland	27,520	53.51
Japan	22,050	40.34
Norway	21,450	46.51
Denmark	21,070	52.87
Sweden	20,750	65.71
Finland	20,040	47.98
Luxembourg	19,620	43.70
USA	19,130	51.99
Germany, Fed Rep	19,060	45.06
Canada	18,110	52.41
France	16,360	43.97
Austria	16,230	38.40
Netherlands	15,030	42.52
Belgium	15,000	33.94
Australia	14,530	43.64
Italy	13,830	33.31
UK	13,560	40.94
New Zealand	13,290	41.98
Israel	9,310	31.86
Germany, Dem Rep	8,960	10.19
Hong Kong	8,490	36.03
Spain	8,310	26.36
Taiwan	5,440	26.21
Greece	5,090	34.69
Syria	4,120	4.25
Czechoslovakia	4,040	13.04
USSR	3,710	9.96
Portugal	3,700	16.00
Argentina	3,080	9.62
Brazil	2,820	5.66
Hungary	2,650	7.65
Uruguay	2,520	10.20
South Africa	2,410	8.08
Mexico	1,590	5.04
Turkey	1,560	7.94
Egypt	1,510	2.41
Paraguay	1,500	2.18
Poland	1,340	7.37
Morocco	750	1.14
Philippines	630	0.95
Peru	490	2.23
Indonesia	420	0.43
Pakistan	360	0.62

Source : Siemens AG, "International Telecom Statistics," May 1989

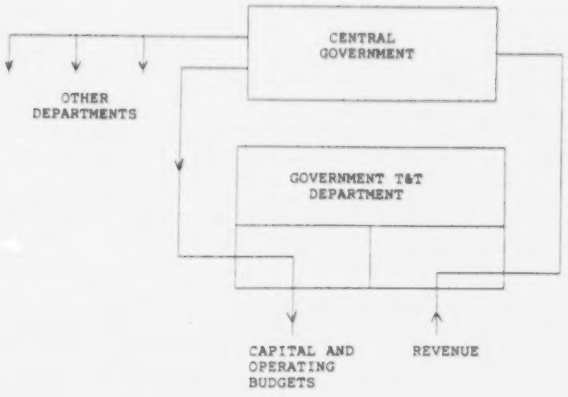
4. TELECOMMUNICATIONS INVESTMENT - THE NEED FOR CONTINUOUS AND GROWING INVESTMENT

Telecommunications demand, particularly in developing countries is of two forms: declared demand and latent demand. Once the network development accelerates and begins to satisfy the declared demand, so the latent demand manifests itself. People who had not even bothered to apply for service, now do so. The growing number of subscribers makes the service more useful and it attracts evenmore customers for this reason. The benefits which even the smallest private industrial, commercial or farming business enjoy from the service means that their peers must seek the same advantage to allow them to compete. The organic growth we are all familiar with has then begun. Unlike many manufacturing and infrastructure investments such as factories, bridges, roads or ships, telecommunications demand a continuing and, usually, growing level of investment year by year. The largely 'upfront' investment profile of these other industries cannot apply to telecommunication operation if demand is to be met and the advantages of a constantly changing technology are to be secured.

5. LINKING REVENUE GROWTH TO INVESTMENT

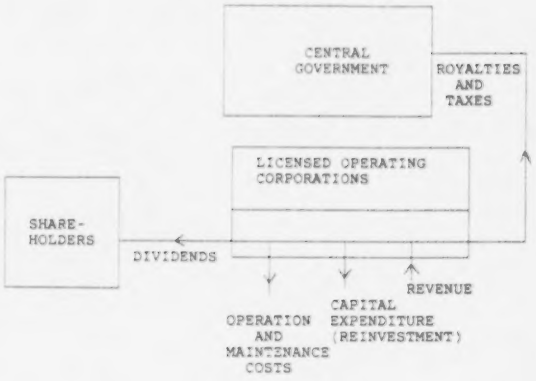
One of the major benefits of 'privatization', in common with 'corporatization' is to enable the growing revenue from the improved facilities to be used to fund further expansion and improvement. The days of Government T&T departments struggling with insufficient budgets while their revenues disappeared into central coffers are fading (Figure 1).

Figure 1 CENTRAL GOVERNMENT ACCOUNTING



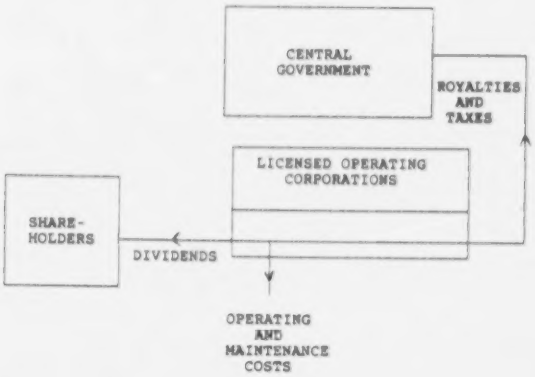
Care is needed however to ensure that the structure adopted for privatization does produce the same result a few years down the line, without losing the momentum of the early growth and improvements in service. (Figure 2, Figure 3).

Figure 2 TELECOMS LINKAGE



The linkage for a private sector bridge or road, involving an "up front" investment but no re-investment differs fundamentally from the above model for telecommunications, viz:

Figure 3 BRIDGE/ROAD LINKAGE AFTER INITIAL INVESTMENT (BOT, BTO STRUCTURE)



If the structure of privatization of telecommunications encourages or makes necessary this latter form of linkage between revenue and expenditure with no re-investment in capital expenditure then the early improvements will not continue.

6. TECHNOLOGY CONSIDERATION

Most countries are now embarking on digitalization programs. Macau is the largest network to achieve 100% digital operation as a result of a decision by the Government only ten years ago to bring private and foreign investment into a Joint Venture. More recent technical innovations in Macau, including a Managed Data Network and cellular mobile services emphasize the change from a cash-starved Government operation in 1981 to one, constantly incorporating new developments, continues. The enlightened Government is now re-negotiating the initial agreement with the Joint Venture shareholders (Cable and Wirleess, CPRM, CITIC and its own T&T Department) so that investment conditions will encourage this to continue even though the original contract still has another ten years to run.

Technical change will not stop and is not even showing any signs of slowing. Dramatic improvements in transmission, switching and software fields can be expected in the next 10/20 years which could make current facilities as old hat as paper/lead cables and Stowger exchanges are now. Developing countries are today urgently seeking to expand the quantity of their telecommunications to bring service to more people and stimulate economic growth in order to and become NIC's. The NIC's of tomorrow will need just as urgently to keep up with technological advances, and the new services these will bring, in order to remain competitive in the international market place. The implication of this for the structure of privatization, in fact adds to the need to find a formula which encourages re-investment and continuous evolution of the network as well as meeting the inexorable growth of demand for service.

7. EVOLUTION OF PRIVATIZATION

Several evolutionary paths can be traced and these depend more or less on how bold the Government concerned is prepared to be in moving from the common starting point of a Government T&T Department monopoly.

T&T Dept ---> State Corporation ---> Joint Venture (Government/Private).
Example: Jamaica.

T&T Dept ---> State Corporation ---> Full Privatization.
Example: New Zealand, UK.

T&T Dept ---> Partial Privatization of some sectors.
Example: Tonga (International), Pakistan (Cellular), Thailand (VSATS).

Supply Contracts ---> BTO.
Example: Vietnam (International), Thailand (Cellular, Paging).

Supply Contracts ---> BOT.
Example: Indonesia (Local Telephone)

T&T Dept ---> Joint Venture.
Example: Macau, Solomon Islands, Vanuatu.

In fact many of the JV's involve some provisions of a BOT, the main difference being in the "intention" of the agreement and the transfer conditions. In a JV, Government often reserves the right to buy out the private sector/foreign partner at a fair price (often net book value) after some minimum period. This is a partnership which can be terminated. The BOT may have a similar terminal payment although more commonly transfer of the assets to Government is at a specific time without compensation. In this case it is just a toll road which may be operated by the private investor for a fixed period to recoup his up front capital expenditure and then the road becomes to Government property. It is clear that BTO and BOT are really mechanisms for selling assets to Government rather than true involvement of the private sector as a long term investor. In this respect they represent only a change in detail and timescale from the traditional role of the supplier, to one who takes on the additional responsibility of an operator for a period to complete the sale process.

8. NEED FOR LEGISLATIVE CHANGE

All countries now seeking the benefits of Privatization in telecommunications started with laws allowing only the Government itself to provide service to the public. These laws are an accident of history but in many cases are still standing in the way of the real benefits of Privatization. Joint Ventures usually require a change to the law even where government has a majority shareholding. Full Privatization always does!

Changing the law may be difficult, particularly in Communist countries where the separation of economic and political reform seems to converge again on this issue. New legislation always involves the total monopoly of the Government department changing although often the JV, which Government can still control, often maintains this monopoly for several years. BOT and BTO arrangements can be "fudged" to be consistent with the old laws by saying the temporary, private sector operator is acting as an agent of the Government which itself retains the monopoly. This fudging always restricts more or less the commercial operation of the service and inevitably places a constraint on ongoing investment. In reality BOT and BTO usually mean that Goverment's day to day control is lost but the private operator is forced to squeeze the maximum return from his initial investment with minimum re-investment particularly in the latter part (probably half) of the immutable operating period. Long term investments and technical innovation in this period would be commercially impossible.

9. COMPARISON OF STRUCTURES

9.1 FULLY PRIVATIZED OPERATION

This is the boldest step leaving government with regulatory control only over the operation (except in cases of national emergency etc). The operator is fully motivated to re-invest for commercial reasons and needs to perform well enough to secure licence renewal. May be in the form of JV between private sector and foreign investor to bring in outside finance and expertize. Often combined with competition in many telecommunication market sectors while continuing the natural monopoly of the basic network services in all but the largest and most sophisticated countries (US, UK, Japan).

9.2 JOINT VENTURE

May be between private and public sector or either and foreign investor. In developing countries the latter bringing rapid overseas investment, training, transfer of technology and committed management experience. The ongoing nature of the partnership, with reviews/extensions built in ensures long term investment, technical innovation in everyone's best interests and tailored to economic, social, security, legislative and political conditions by nature of JV agreement. Organic growth encouraged by commercial, social and economic factors.

9.3 BOT

Revenue from operation used to pay for specific equipment which will be provided as quickly as possible to maximise revenue during fixed operating period. Operator has no real interest in what happens after his operating period. Investment group often includes supplier as means of financing his equipment sale. Government eventually gets equipment which may be obsolete or approaching it by that time <u>but</u> without actually paying money. Investor can use normal depreciation if net book transfer is provided for. If there is zero compensation at transfer, the resulting accelerated depreciation must dampen re-investment eventually to zero, make financing impossible in later stage and impact on tariffs and taxes. Ideally the operator should finish the period by connecting the last possible new customer on the last day using technology which has been fully depreciated and therefore due for replacement.

9.4 BTO

This has most of the features of BOT but presents an accounting and legal problem for many foreign investors who are operators. The assets are transferred to government at once, before operation starts. The operator then has on his books a "right to use" the assets rather than title to them. In practical terms it may be the same although BTO's often involve restriction of the freedom of investment decisions by the operator making the relationship even more like an equipment supply contract with long term, high risk financing. Back at the ranch, in the foreign operator's corporate headquarters, some legal gymnestics and creative accounting are needed to record for posterity, and more particularly for the shareholders, what the company got for its money.

10. HOW DO THEY MEET OBJECTIVES

This paper aims only to compare how well the various structures meet the objectives which any particular Government may have relative to the above considerations. No conclusions are possible as they will depend on the weighting of the objectives in each individual case.

The objectives assume a Government T&T Department or State owned Corporation starting point.

The Revenue accruing to Government is relatively independant of the structure and is decided by the details of the individual agreement and the degree of commercial success achieved.

From the point of view of a foreign operator the Joint Venture and Full Privatization are generally more acceptable; the preference between these depending largely on individual corporate background. Some US companies seem to prefer 100% private ownership while Europeans like Cable and Wireless look for Joint Ventures with Governments but there are almost as many exceptions as examples of these gross over-simplification.

Following the examples of various motoring magazines and consumer publications, a "Buyers Guide" (Table 2) is offered in the hope that it may encourage an ongoing discussion of the subject in "consumer countries". The greater the number of stars, the more the objective concerned seems to be met! Those structures involving long term private sector and foreign investment are clearly better in meeting the objectives related to service, demand and technology. The BTO/BOT formula shows advantages in avoiding regulatory change and retaining Government influence or control. The latter is shown as much less significant when it really matters in terms of National Emergencies and Security.

TABLE 2 BUYERS GUIDE TO TELECOM PRIVATIZATION

	Ease of Regulatory Transition	Ensure Ongoing Investment	Avoid Technical Obsolescence	Encourage Foreign Investment	Long Term Investor Commitment	Reactive to Socio-economic Needs	Government Influence Ongoing Investment	Government Retain Daily Control	National Security Guarantees
FULLY PRIVATIZED (FOREIGN UPTO 100%)	★	★★★	★★★★	★★★★	★★★★	★★★	★		★★★
JV PRIVATE SECTOR / FOREIGN	★	★★★	★★★★	★★★★	★★★★	★★★	★		★★
JV GOVT / FOREIGN	★★	★★★★	★★★★	★★★★	★★★★	★★★★	★★★	★	★★★★
BOT	★★★			★	★	★		★	★★
BTO	★★★★		★			★	★	★★★	★★★★

11. CONCLUSION

There is no conclusion offered - only an observation. If the outline of structures and the checklist stimulates productive discussion in the corridors of power of some developing countries, NICs and would be NIC's, to time spent in preparing the paper and reading it will be more than justified.

And the observation:

For many Governments the bold step to Telecommunications Privatization is a difficult one to take. None who have taken it have had reason to regret it but it is worth devoting the time and honesty to take it properly. Fudging the step now will stare up disillusion and lost chances for which history will be the judge.

THE NORTH PACIFIC CABLE

Charting a Course for International Alliances

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1. ABSTRACT

With proper structuring, an understanding of the business culture of other nations and a willingness to negotiate on critical issues, international alliances can be successfully implemented. The North Pacific Cable project, an alliance between American, British and Japanese interests, is a real world example of how such alliances are formed and how they function.

2. INTRODUCTION

In 1986, a strategic alliance was formed by American, British and Japanese parties to construct the North Pacific Cable. NPC is the first direct trans-Pacific fiber optic cable link between the U.S. and Japan and the highest capacity cable in the Pacific. Through its Alaskan spur, it also provides the first fiber link between Alaska and the contiguous 48 states.

NPC's founding parties are Pacific Telecom Cable, Inc. (U.S.), Cable and Wireless plc (U.K.) and International Digital Communications Inc. (Japan). Since the establishment of the project, NPC's owners have expanded to include 34 carriers and administrations from 21 countries. Approximately 50 percent of NPC's U.S. - Japan capacity (1,260 Mbit/s) and all of its Alaska - contiguous U.S. capacity (420 Mbit/s) has been acquired by these organizations. The cable was commercially activated May 10, 1991.

While the 5,200-mile NPC represents a successful alliance between firms of three nations, the road to success was not always smooth. The real world experiences of NPC should prove useful to others seeking to establish joint ventures or strategic alliances for international projects.

3. ORIGINAL OWNERSHIP AND BACKGROUND

Original ownership shares in the Japan end of NPC were held 70 percent by International Digital Communications Inc. and 30 percent by Cable and Wireless plc. This ownership split was a result of nine months of negotiations. During this period, the total cable capacity, the expectations of Japanese traffic (terminal vs. transit), and the needs and risks of such an ambitious project were discussed and negotiated extensively among the three parties and with Japanese regulatory agencies.

IDC was formed in 1987 to compete with KDD, Japan's then monopoly international carrier, much as MCI and US Sprint compete with AT&T. Some 144 companies, including 39 of the top 50 most profitable firms in Japan, are shareholders in IDC. C. Itoh, the largest Japanese trading company (with more than $150 billion in sales), Cable and Wireless, Toyota and Pacific Telesis are the largest shareholders in IDC. American participation also includes Merrill Lynch.

Original ownership of the U.S. end was 100 percent by Pacific Telecom Cable, Inc. PTC, in turn, is owned 80 percent by Pacific Telecom, Inc., the telecommunications subsidiary of PacifiCorp, and 20 percent by Cable and Wireless.

For the funding of NPC, owners of the U.S. end contributed 56.63 percent of the capital while the Japan-end owners contributed 43.37 percent. These percentages evolved as a result of two years of negotiations.

The length of time it took to establish the ownership shares of the Japan end and the funding of NPC illustrates the importance of patience in negotiating international projects. But another important lesson in the success of a project is the ongoing willingness of the parties to put aside their respective ownership positions during ongoing negotiating sessions. The reason why each partner must have an "equal voice" regardless of their financial position will be covered later.

But there is more than funding to assure the success of a venture. In the case of NPC, each of the three parties brought something else to the table.

IDC, in addition to its funding capability, provides a needed presence in Japan, while its shareholders comprise a large customer base for service on

the cable. Each of its shareholders was chosen in part because of its international telecommunications requirements.

C&W is a worldwide recognized carrier. For example, C&W runs the international telecoms services for Bermuda, the Bahamas, Hong Kong, Bahrain and numerous other locations. Its Mercury Communications subsidiary competes with British Telecom in the United Kingdom. C&W is also a leader in procuring and installing submarine cable systems through its subsidiary, Cable and Wireless (Marine), and in operating submarine cable systems through a number of its subsidiaries. C&W (Marine) has the largest cableship fleet in the world, currently numbering 13 vessels. This compares to the three ships (plus one under construction) of AT&T. Many C&W cableships are equipped with remotely controlled submersible vehicles for cable burial and maintenance.

PTC in the United States obtained the U.S. landing license from the FCC. As one of the nation's largest non-Bell telephone companies, PTC's parent PTI contributed telecommunications expertise to the project.

Together, the founding parties have shared not only in capital but in a willingness to bear the risk of a new venture.

4. MAKING AN ALLIANCE WORK

Several things combine to make an international alliance work. First, a successful alliance presumes opportunity. In the case of NPC, the opportunity was a need for services not being met by other suppliers. This need was recognized by the Federal Communications Commission in granting PTC a license to land the cable in the U.S. Benefits cited by the Commission include:

-- service on a non-common carrier basis
-- assurances of availability and price
-- custom-tailored service arrangements, and
-- encouraging new service offerings.

NPC contributes to service reliability in the Pacific by providing alternate routing for other systems planned for installation in the 1990s. This deserves additional comment.

Although trans-Pacific traffic growth was booming at the time NPC was first envisioned in 1985, there were those who argued that the planned HAW-4/TPC-3 cable would satisfy demand until the year 2000. These predictions were used by Japan's telecommunications industry and regulatory powers to delay by more than nine months granting IDC its license to land and operate NPC in Japan. The forecasts in traffic growth by NPC's owners indicated otherwise and have since been vindicated by the announcement of TPC-4 and TPC-5 as common carrier cables.

Opportunities for successful ventures are also enhanced when high-quality services are offered at a lower price. NPC's high capacity and direct routing between the U.S. and Japan has resulted in circuit costs some one-third those of HAW-4/TPC-3.

Another ingredient to a successful venture is commonality of purpose. The venture must mesh with the business requirements of the participants. Otherwise there is danger that commitment may abate.

A new trans-Pacific fiber cable was a good "fit" for the long-term goals of each of the three founding parties. For IDC, a newly licensed Japanese international carrier, it is a means of using its own facilities in competing with the other two Japanese international service carriers.

For Cable and Wireless, NPC is an ideal way to extend its "global digital highway" across the Pacific to connect its markets in the Far East with those in the U.S. and Europe. In particular, C&W envisioned a London-Hong Kong fiber service. NPC is the last link in this portion of their digital highway.

Pacific Telecom views NPC as a means of providing a fiber route between its Alaskan carrier, Alascom, Inc., and the lower 48 states, and to expand its business beyond the services of its many local telephone companies.

5. THE COLD WATERS OF REALITY

These ingredients - bringing something to the table, serving the market, and commonality of purpose - are classic business school requirements for any alliance. But what is often missed in the classroom can provide some surprises in the real world. Let's now turn to some difficulties to be aware of.

My last sentence is an example. It's "American English." In "English English," a sentence would never end with a preposition. The NPC project blends Japanese, American English and English English -- a good environment for language barriers.

When East and West meet in joint

ventures, patience and understanding are essential. The varied cultures mean different ways of addressing and resolving problems, of running meetings and negotiating with contractors. These differences are compounded when negotiations are conducted over 18 time zones. Participants must plan and budget for extensive and expensive travel associated with attendance at the requisite international meetings.

For a successful multinational project the American inclination for getting it done "now" must take a back seat as the time required for decision-making is extended. Similarly, the American fondness for logical analysis and fancy footwork must be tempered to accommodate the Japanese desire for harmony and trust, and the British emphasis on the proper approach to resolving any problem.

Given these differences in national character, international joint ventures might better be called joint compromises. The ability of participants to be ready and willing to compromise for the success of the overall project is something that can go against the grain of some hard-negotiating companies.

NPC is a success because in each instance where there were differences of opinion, the founding parties were able to reach consensus. Consensus building must have nothing to do with the relative financial input or ownership percentage of the parties, otherwise those with a smaller share will soon lose interest. This concern was touched on earlier in discussing the impact of ownership positions on managing an alliance. Anyone considering an international alliance must be willing to "win some/lose some" for the overall success of the project.

Lastly, don't be surprised if you have problems with regulatory bodies and competition. In addition to its licensing delays, IDC faced another difficult period when the Ministry urged that it unite with ITJ, the second new international carrier licensed in Japan, so that KDD would have but one competitor. Pacific Telecom Cable was subjected to several cautions by the FCC concerning the selection of vendors for NPC components and installation. While there may have been good reason for these cautions, nevertheless they required substantial additional effort to ensure compliance.

6. STRENGTHENING THE TIES

Strong international relationships are particularly important for multinational ventures of long duration such as a trans-oceanic cable with a 25-year service life. The harmonious environment built over the past five years was instrumental in helping the original three owners quickly respond to two service outages early in the life of the cable. But more importantly, earlier efforts by NPC's original owners to formulate restoration procedures to respond to a cable failure meant that traffic was restored via satellite in the unprecedented time of just over one hour following both outages.

And as a final measure of success, the original three founders of NPC have agreed to continue their relationship by forming another strategic alliance to construct and operate a new cableship for the purpose of maintaining the NPC system. The new ship will be berthed in the Pacific Northwest. While its primary purpose will be to serve the needs of NPC, it could also be made available for other services in the Eastern Pacific.

7. CONCLUSION

International alliances can be successful if there's patience, understanding and a mutual respect for cultural differences; if consensus can be reached despite individual interests of the parties, and if the project fits into the participants' business plans. The road to success may not always be smooth, but when success is achieved, it opens the door to new opportunities.

Graphical Communication Network Simulator

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Abstract

A new approach for network simulation based on graphical representation of network topology and its protocols has been implemented on X window. The protocol represented by Petri nets with extended features can be drawn to specifications. Service discipline and routing strategy can be entered by pull down menus. A simulation model is automatically generated from the representation and simulation results are displayed in graphical form.

1 Introduction

In a computer communication network (e.g., X.25), users share dynamically a distributed pool of resources such as buffers, communication channels [1]. Mathematical analysis with simplifying assumptions has been found useful to study different routing and flow control schemes [2]. However, assumptions such as unlimited nodal buffers, exponential packet length and probabilistic routing are not realistic. In fact, nodal buffers are not infinite, and limited buffer size as well as buffer allocation discipline among competing users will affect performance characteristics such as delay, throughput, queue length and processor's utilization. Therefore simulation models are often used to study a more realistic situation where fixed packet length and status-dependent routing are used.

Traditionally, simulation languages [3] or simulation packages [4] may be used to construct models for specific applications. However, the designers are not free from transforming their conceptual network model to the detail code of the simulation language. In addition, only statistics in numerical form are available at the end of the simulation run and the output is often hard to interpret. Some efforts have been made toward graphical interfaces which are built ad hoc on top of the underlying language [5], but they are neither efficient nor user friendly. Operationally one has to follow very closely the underlying language construction. Subsequently the designer is still burdened with providing all the operational details.

A graphical approach for network simulation has been designed for users to specify the network requirements in a much easier way than using programming languages. In order to reduce the difficulties associated with modeling a complex system such as a communication network, three major program modules, namely topology, nodes, and protocol modules are used to define the network. The topology module describes the physical layout of the network as well as the physical transmission characteristics of the medium. The node module specifies the attributes of the devices (e.g., switching centers) in the network. The protocol module specifies the rules for communication on each link. Additional modules, namely simulation core and statistic control modules are provided to carry out the simulation and display the statistical results in graphical form.

The simulator supports process interruption and termination. With interruption control, users are free to examine the current status of the network during the simulation. The process can later be resumed. With termination control, the simulation process can be terminated at any time and the process control will be returned to the user interface.

2 Approach and Requirements

In this section we describe the requirements for the simulator and the approach we take to reduce the difficulties associated with modeling such a complex system.

The simulator should allow heterogeneous jobs in the system i.e., each class of jobs has its own set of attributes. Routing of these jobs depends not only on the topology, but also on their attribute values. The simulator should be able to simulate two types of network simulation, namely open network where there is no limit on the number of jobs created [6] and closed network where the number of jobs in the network is fixed [7]. Jobs are created from the source node and circulated in the network in accordance to the routing strategy. Measures such as total delay and throughput should be available at the end of simulation runs. Statistic on nodes, links and queues e.g., their utilization and queue length should be readily obtained.

2.1 Topology Module

The topology of a network defines the way in which information is propagated on the transmission medium. The network is modeled as a set of resources (e.g., communication links, buffers) and a set of jobs (e.g., packets, acknowledgment, messages, etc.) interacted in certain ways. The actual physical layout of nodes, links, together with their characteristics has to be defined. Therefore the topology is drawn as a set of junctions

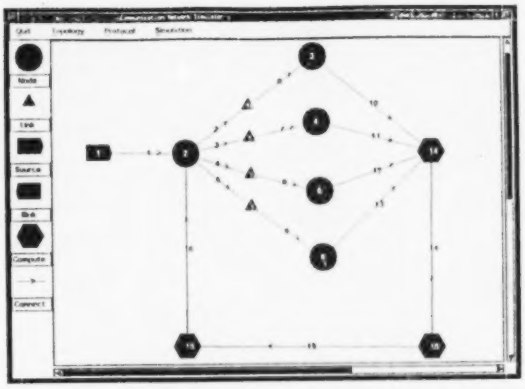


Figure 1: topology specification

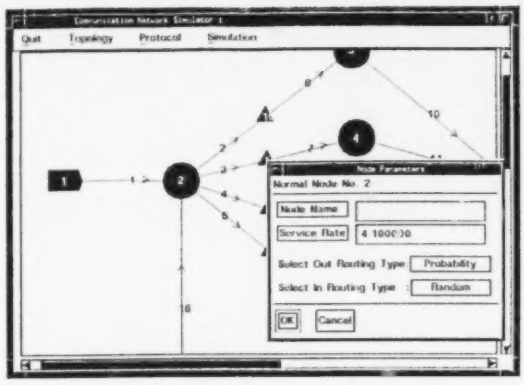


Figure 2: node parameters

(nodes, links, sources, sinks), and a set of connectors which are directional arcs that originate from one junction and destinate to another junction (Figure 1).

2.2 Node Module

After the topology has been defined, the characteristics of the devices must be specified. The following list of parameters for the nodes may be given:

- name and the service rate (Figure 2)
- capacity of the incoming and outgoing buffers with their corresponding queueing discipline
- strategy of choosing an incoming buffer which may be random, probabilistic, prioritized, status-dependent (e.g., current queue length or queueing time)
- strategy of choosing an outgoing buffer which may be random, probabilistic, prioritized, status-dependent (e.g., current queue length) or the status of the target node connected with each outgoing buffer
- job attribute routing, explained in section 4.1.2

2.3 Protocol Module

In specifying a communication protocol on a link, a graph-based model [8] is used in the simulator. This is the Petri net model which composed of a set of places possibly with a token in it, a set of triggers, and a set of directed arcs. A place represents a state and a trigger represents a transition of the system. The arcs connect places and triggers. Tokens are located at a place when it is active. Multiple places leading into one trigger represent a boolean AND condition. A trigger has one or more input arcs, coming from its input places, and one or more output arcs, going to its output places. A trigger is enabled if there is at least one input token in each of its input places. Any enabled trigger may fire denoting an occurrence of the transition, removing one token from each input place and depositing a token in each output place. If two or more triggers are enabled, any one of them may fire.

Petri nets provide a means of describing a protocol. However, several modifications to the basic Petri net are needed to model additional features such as delays in communication network. First, in our specification, the role of the token has been enhanced by incorporating a list of attributes associated with each token for identification. Second, basic Petri nets have no time delays associated with the trigger. In a discrete event simulation, scheduling events after a specific time delay is essential so delay trigger is introduced to model time delay. When a token enters a place connecting to the delay trigger, it will be delayed for the specified time period which may be deterministic or stochastic. Some other transitions may cause the firing of the delay trigger. Therefore this delay time can also be interrupted by another place if both places lead to firing of the trigger. Third, Petri nets are not designed to represent layers of protocol in the OSI reference model. In the basic Petri net, all elements of the protocol must appear in the same network diagram. In order to associate a protocol with a link, two predefined places SOT and EOT are used in all protocol specifications. SOT represents the start of transmission and EOT represents the end of transmission. An example is given in Figure 3.

In basic Petri nets, when a trigger is fired, the tokens from the input places are removed. One token is sent to the trigger, and the others are destroyed. There is no facility to specify which token will pass to the trigger. Information stored in the attributes of a token can be lost if the wrong token is sent to the trigger. Therefore a flag is set to indicate where the information are stored in that place. Hence, when a trigger is fired, the token from the input place having the flag set would be stored and then passed to the output place with its flag also being set.

After the protocol has been drawn, the parameters of the delay trigger such as the delay distribution and parameters of the places such as the flag to indicate

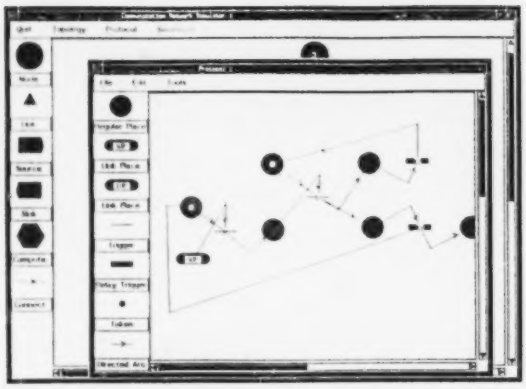


Figure 3: Petri net

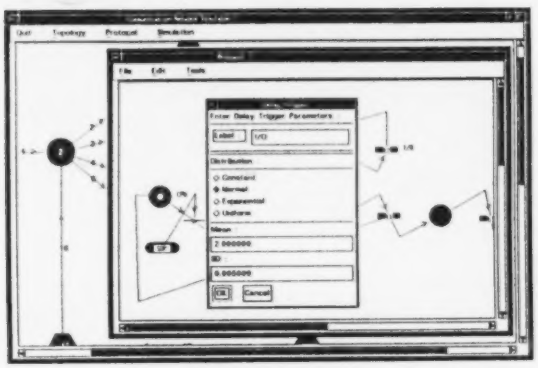


Figure 4: Delay trigger

whether it is needed to store the information of the token must be given (Figure 4).

2.4 Simulation and Statistic Control Module

The simulation should be run for number of times to provide statistical analysis of the output data. Users are free to input any number of batches by which each run of the simulation will be divided [9]. Both the transient-state and the steady-state behavior of the simulation can be observed on the statistic output graph. Users should also be able to give any level of confidence to the statistic charts and the variance of the data collected during the simulation can then be observed.

3 User Interface

3.1 Design of the User Interface

It is easier to define the topology layout in graphical form by selecting proper icons using the mouse. On the other hand, it is appropriate to enter numerical values such as probability distributions by using menu. Therefore an interface with the following features has been constructed:

3.1.1 User friendly

Topology and protocol specification are better expressed in graphics while statistical results from simulation are better expressed in charts instead of numerical figures. These services could be provided by popup menu activated directly by pressing a particular icon. Number of level and amount of information on each menu must be minimal for efficient operation otherwise the user may have to select from a long list of functions. Therefore appropriate grouping of functions are provided so that primary data can be input. In addition, default values has been defined for some commonly used values, e.g., single server at the node. Option menu are also available for the user to recall data values. Resizable previewers and scrolled bars are provided to help users access particular drawing regions on the screen.

3.1.2 Minimize input errors

Error menu are prompted whenever errors are detected. The error message indicates the nature of the error and any correction needed to be done. A logical usage of the functions is enforced e.g., drawing mode is not mixed with input mode, to minimize input error. Another feature is to deactivate those items that are not currently meaningful.

3.1.3 Use appropriate colors/ icon shape/ operation appearance

Menu colors for topology and protocol input are different such that distinct multiple menu could be seen on screen. Also background color for the drawing area is different from that for the pulldown menu for easy identification. Different icon shape related to its meaning is used. Rubber band lines are used as an indication of a not yet finished line. This function allows users observe the partially finished line e.g., turning points in the Petri Net model for the protocol input, before deciding on the final drawing.

3.2 Construction of the User Interface

3.2.1 Topology Input

If an unselected icon is picked from the icon list, it will be inverted in color to indicate that it is chosen. If a previous selected icon is picked, it will return to its normal color to indicate that it becomes unselected. To achieve this, both the previously selected icon index and the currently selected icon index must be stored in order to give the necessary effect. To make the number of icons available on the list flexible, all icon options are implemented by array manipulation. A direct index can be used to access an indexed icon.

To draw an icon on screen requires two steps, namely direct the icon to the desired location and draw the

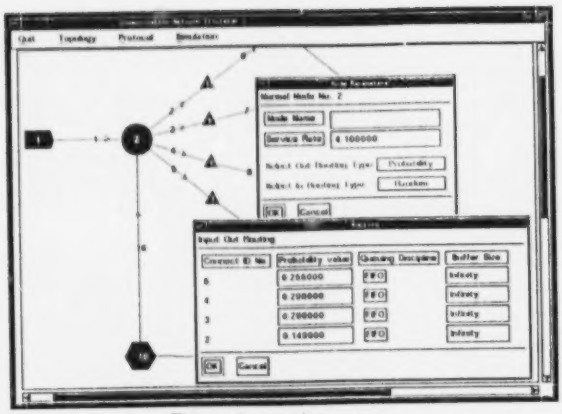


Figure 5: routing menu

icon. The method used is to operate in an exclusive-or mode (XOR) so that two consecutive drawings will cancel each. This is particularly suitable for simulating the effect of a moving icon. In case of line drawing, particularly the directed arc in protocol, flags are used to denote different cases for optimal effect.

Redrawing requires possibly a large amount of bitmap information stored on the drawing area to be refreshed. Internal data structure is traversed and drawing area is updated. Size of icon can also be changed to meet the user's requirement. This is achieved by giving a ratio for each icon drawing function.

3.2.2 Data Input and Display

Menu for input are constructed from a set of widgets on X [10]. They are customerized according to specifics, e.g., for the routing menu, the number of row corresponds to the number of outgoing/incoming links while the number of columns corresponds to the routing type (Figure 5). Certain fields on the menu will be deactivated to minimize user error if data has to be entered in sequence. An intensive error checking is imposed upon the data items, e.g., data type, invalid sequence of operation, inconsistence between data items. The user is then allowed to make corrections. To protect accidental erasure of important data, warning or confirmation menu are prompted.

4 Implementation

4.1 Data-Building Module

Data-Building (DB) Module is a module which serves as a bridge between the user interface which is described in the last section and Simulation Core Module, the core for simulation. DB Module has three main components.

4.1.1 Network Topology

Network topology is consisted of source, sink, normal, compute nodes and link server (Figure 1). Connectors

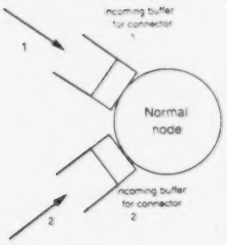
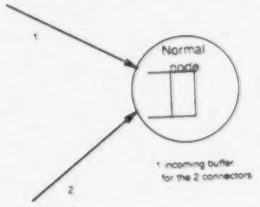


Figure 6: buffers for each link



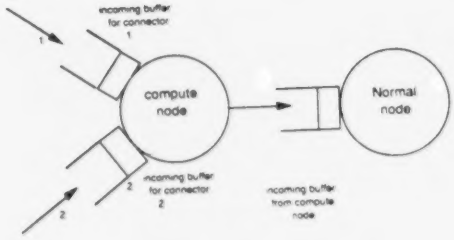


Figure 7: sharing common buffers

are used to connect a node with a link server. They connect source, normal or compute nodes to a link server and from a link server to normal, sink or compute nodes. Normal nodes correspond to switching centers and link servers correspond to transmission channels. The relationships between the nodes and the link servers are as follow.

- There is no incoming connector for source node and no outgoing connector for the sink node.
- There can be more than one outgoing and one incoming connector for the normal node and compute node.
- There can be only one outgoing and one incoming connector for the link server.

In our initial design, node buffers are associated directly with the connectors, illustrated in Figure 6. This shows that each connector has its own partition of buffers. However, the simulator is not able to simulate sharing a common pool of buffers. Therefore a compute node with zero service time is used to achieve sharing a common buffer pool as illustrated in Figure 7.

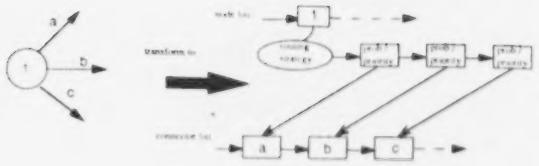


Figure 8: routing implementation

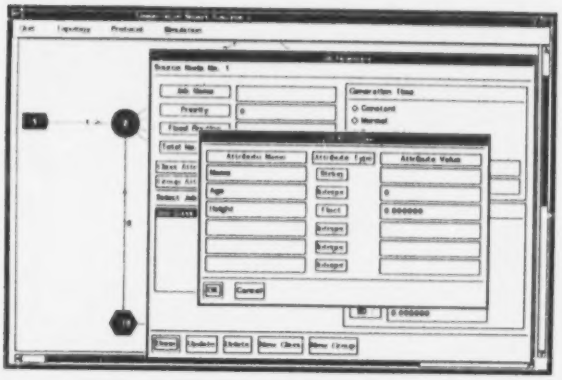


Figure 9: job's attribute

4.1.2 Jobs in the Network

Basically there are four types of routing strategies after a job has been served in a normal or compute node:

1. Random: each connector has equal probability of being chosen as an outgoing path.
2. Probabilistic: each connector is assigned a probability of being chosen for routing
3. Priority: each connector is assigned with a priority number. The connector with the highest priority is chosen. If the highest priority connector is full, the second higher priority connector is chosen and so on.
4. Current status: the connector selected is determined by the current status of the system, namely queue length of the connectors, queueing time and status of the opposite node on the connector. Its structure is illustrated in Figure 8.

A useful feature provided in the simulator is job's attribute routing where the routing depends on the job's attribute values. Jobs may be categorized into classes. Each class can have its own set of job attributes and a maximum of six attributes for each job class can be specified (Figure 9). For each attributes, three different types of value are possible, namely integer, float and string. For each job class, an independent set of conditions is used to determine its routing strategy. If each job class uses its set of attribute and attribute values

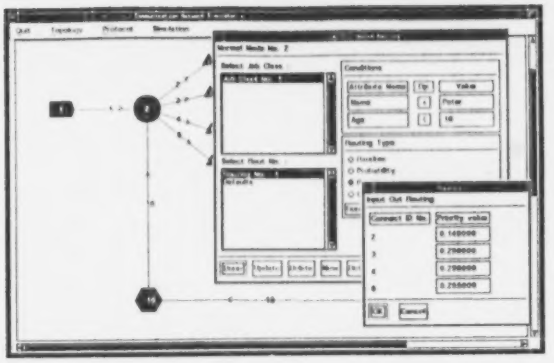


Figure 10: attribute routing

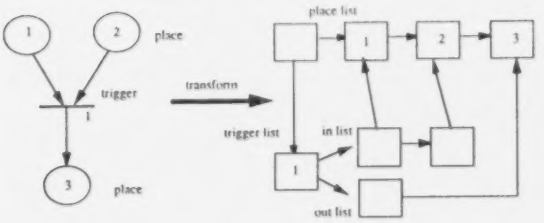


Figure 11: transformation of Petri net

for routing, then each member in the class must satisfy the same condition and follow the same routing strategy (Figure 10). If the job class is further classified into groups, each group can have different attribute values for the same set of attribute names. This implies that different groups within the same job class can have different routing strategies.

4.1.3 Communication Protocol

Protocols are described by Petri nets consisting of four components, namely places, delay trigger, trigger and directed arcs It is used to control the flow of jobs between two normal nodes. Places, triggers are represented by link lists while the arcs that directed in and directed out from the trigger are represented by an in- and an out- lists respectively. Figure 11 shows an instance of Petri net which is transformed into the corresponding link lists.

4.2 Interaction between User Interface and DB Module

The user interface passes information to the DB Module by a series of predefined function calls. For data input or figures drawn on the drawing region, the data has to be validated and stored into the corresponding structure. Five main function calls are provided by the DB Module:

1. Add node functions

When the user draws a node on the drawing area, the information regarding this node such as the x- and y- coordinates will be passed to the DB Module. The add node function checks the validity of the drawing (e.g., no overlap with other icons in the drawing area). After validation, the node information will be put into the corresponding structure. The data required by the node (e.g., service rate) will also be input by the function call.

2. Add connector functions

   The connector contains tail and the head coordinates. When this information is passed to the DB Module by the add connector function, the coordinates will be checked to determine whether they are within the neighborhood of some nodes. Whether the connector is connected with the nodes in a proper way (e.g., normal node cannot be directly connected to another normal node without going through a link server) will also be checked. After validation, it is put into the corresponding structure.

3. Add job functions

   The user interface can call the add job function to create a new class of jobs or a group of an existing class of jobs. The data required by the job class (e.g., generation rate and job size) are passed by the function call to the structures for jobs. If fixed routing path is given for the job, the DB Module will check the validity of the routing path. If the path is valid, it will be put into the corresponding structure.

4. Add protocol functions

   When the user draws a protocol model or loads a protocol from a file, the DB Module will build the corresponding structure. An independent protocol structure for each of the associated links will be reproduced. Furthermore, the add protocol functions consist of add place and trigger functions, and add arc functions. Both the add place and trigger functions, and the add arc functions which add directed arcs from the place to the trigger or vice versa are checked for validatity (e.g., it is illegal to direct the arc from place to place or from trigger to trigger) before putting into corresponding structure.

5. Add routing functions

   After the topology of the network has been defined, the routing strategy has to be specified together with other information (e.g., probability value/ priority value for each connector). It is simple for four basic routing strategies. For attribute routing, both the routing and the input conditions have to be checked for correctness. For example, the data type of the job's attribute has to match with the type of the input data.

Input and default data values can be shown by pop up menu from the user interface which calls the DB Module for the information. Again the user interface uses a series of predefined functions available in the DB Module. For example, if the user wants to display the service rate of a normal node, the function will search for the right node and gets its service rate.

Thus, DB Module provides a library of functions for the user interface to utilize. In this way independence between the DB Module and user interface can be obtained. The user interface module does not need to take care or even know about the data structure of the model. It only needs to call the predefined functions to build the data structure and gets the data value. The building and retrieval processes which are the main functions of the DB Module are completely hidden from the user interface. Therefore modification of the data structure is transparent to users.

4.3 Interaction between DB Module and Simulation Core

DB Module creates the event list of jobs for the simulation. The list contains the job generation event and the end event of simulation. This list is passed to the simulation core which manipulates the data structure during the simulation process. Additional interaction involves two separate text files, namely network and protocol files. Network file contains information for node, connector, job and attribute routing of the network. Protocol file contains information for places, triggers and directed arcs of the protocol. Therefore, performance of different protocols can be compared by loading the protocol models for the same network configuration. DB Module is responsible for saving and loading of these network and protocol files.

In summary, DB Module is a module that communicates with both the user interface and the simulation core. The module contains a library of functions for the construction of network and protocol data structures which are hidden from the user interface. The module also provides functions to load and save information files which could be reused in different network and protocol configurations. This collective set of functions is designed such that it is not built around any particular program design. Therefore future enhancement of the system will not be confined by the design.

5 Statistics Collection

During simulation, the system has random inputs consisting of sequences of random variables with specific distributions. These variables represent the probablistic nature of the system, such as job generation time, node service time, etc. Correspondingly, random outputs consisting of sequences of variables such as node utilization, throughput of the system are characterized with an unknown distribution. The characteristics of these output distributions have to be estimated.

The user is mostly interested in the steady state results of the simulation. In this case, the simulation

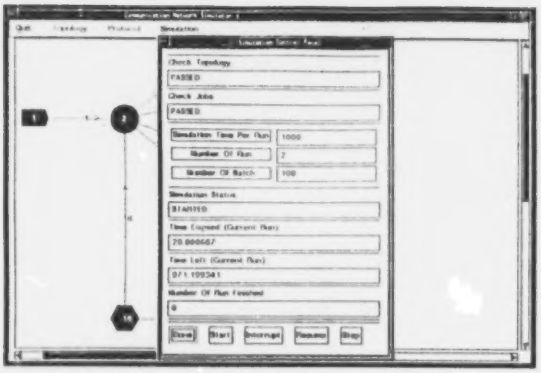


Figure 12: simulation panel

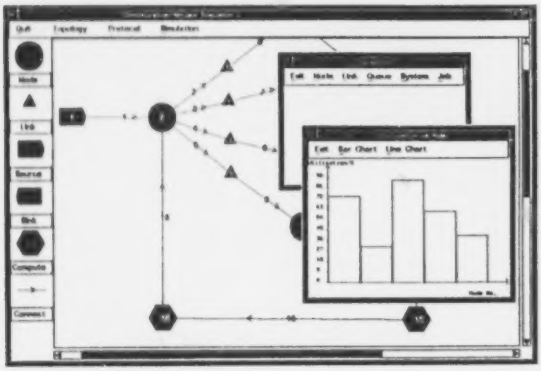


Figure 13: bar chart and line chart

must typically be run for a long period when performance measure will be collected and analyzed such that effects of the initial state on the performance measure are negligible. Moreover the user is allowed to specify the number of run for each simulation. A single run of simulation is divided into N equal time intervals given by user. Replications are made by using nonoverlapping independent streams of random number, so that classical statistical analytical methods could be applied (Figure 12).

During simulation, statistics are stored in the data structure. The statistical graphs can then be plotted by getting the information from the data structures. Ten statistic output results are available from the simulator. They are presented as bar chart or line chart illustrated in Figure 13. At most four different type of graphs could be displayed on the screen simultaneously, so that comparison could be made. The size of the graphs could also be adjusted by resizing the drawing area. All statistic outputs are handled mainly by three routines, namely, plotting the x- and y - axis, bar chart and the line chart. The routine rounds off the data by two significant figures. An additional routine is used to plot the confidential interval for the system throughput.

Nearly all the output graphs are plotted in ratio instead of plotted by absolute value and eleven graphical statistic graphs are provided:

1. node utilization Vs normal node
   normal node utilization - node total busy time / total simulation time
2. link utilization Vs link node
   link utilization - link total busy time / total simulation time.
3. max queue length ratio Vs queue
   max queue length ratio - Peak queue length / queue size
4. min queue length Vs queue
   min queue length ratio - min queue length / queue size
5. average queue length Vs queue
   average queue length ratio - average queue length / queue size
6. max queue time Vs queue
   This is an absolute value not ratio graph.
7. average queue time Vs queue
   This is an absolute value graph.
8. system throughput Vs simulation time
   system throughput - number of job finished / number of job created

   Confidence interval can be computed if multiple runs are made for the simulation. If the simulation is run m times and each run is divided into N equal time intervals, m samples for each period of time could be obtained. Users can use this graph to determine the variance of each collected set of samples. This graph gives the overall system throughput which allows the transient portion and the steady portion of the system to be determined.
9. number of job delay Vs delay time
   number of job delay - number of finished jobs
10. job delay Vs delay time (for specific job class)
    In this graph, the result is plot for each job class
11. throughput for each job class Vs job class
    throughput for each job class - number of job finished for this job class / number of job created for this job class

Users can only roughly estimate the output values from the graphical outputs. So some important data values can be obtained from five data report files.

1. *node.stat* - reports the node utilization for each node
2. *link.stat* - reports the link utilization for each link
3. *queue.stat* - reports the maximum queue length, average queue length, minimum queue length, maximum queueing time, minimum queueing time for each queue

4. *job.stat* - reports the job throughput for each job class i.e., the number of job finished and number of job created for each job class

5. *logfile* - reports the absolute values of the graphical data consisting of the following statistics:

   - node statistic - statistic of total busy time and total idle time for each node, namely compute, source, link and normal in the network.
   - connector statistic - maximum queue length, minimum queue length, current queue length, maximum queue time, number of job arrival and average queue time for each queue in the network.
   - job statistic - total number of job finished, number of job created, number of job active in node and number of job queued in the network for each job class.
   - system throughput - the system throughput of the simulation in discrete time intervals (number of intervals is given by the user before the simulation)
   - time used - the user time, system time and CPU time used in the simulation.

6 Conclusions

We have designed and implemented a user friendly system interface for network simulation using mouse to input the communication network model on screen. Output will be displayed in color graphics. The methodology can simplify the design of a complex communication system with a high degree of flexibility provided by the graphical input approach. This will have a practical impact in shortening the design cycle, significantly reducing the time required to interpret the result. In addition, it reduces the time for debugging and testing of the model.

Future extensions can be incorporated in the simulator. First, the job attribute values are used in determining the routing strategy. In the same class, jobs with different attribute values may choose different routing strategies. If the attribute values can be changed according to some conditions, jobs with the same initial attribute values can have different routing strategies after entering into the network. Second, the service rate at each node is assumed to be constant. It can be modified to give different service rates for different job class. Third, places used in the Petri net refer to the status of the associated link only. Protocol on the link does not interact with other protocols on other links. End-to-end subnet protocol can be simulated by introducing some common places to the Petri net for interaction. Fourth, four groups of accessing strategies, namely, random, probability, priority, and current status are provided. However, other strategies can be easily implemented. For example, since job priority and job size are available in the simulator, exhausted polling or round robin policy can be simulated on multiple queues. Lastly, four types of distributions, namely, random, uniform, exponential and normal are supported. Other distributions (such as Erlang, hyperexponential) can also be easily introduced.

Acknowledgment

The author wishes to thank Chan Chi Kin, Lai Hing Ming and Li Chun Chung for their programming effort in the implementation.

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VARIOUS METHODS OF LAN-WAN CONNECTION

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This paper introduces various methods of LAN-WAN connections that are often seen in offices and factories. The LAN-WAN connections are analyzed from two aspects: LAN-WAN connecting unit and WAN type. The LAN-WAN connecting units are classified by each function , and their desirable connections are introduced. The application ranges of WAN is evaluated by traffic and speed. In particular, the application ranges by traffic will be analyzed by considering the LAN-WAN traffic characteristics.

1. INTRODUCTION

Companies are adopting LAN in their offices and factories to reduce the number of cables, to install OA servers, and to achieve peer to peer connection. At the initial implementation stage, LAN were mainly introduced into individual offices or factories for closed processing. However, communication between offices and factories has gradually become more important. This has increased the demand for LAN-WAN connections to connect plural LAN within each office or factory. (See Figure 1.)

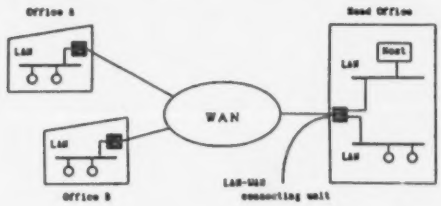

Figure 1 General LAN-WAN connection

There are a great many patterns of LAN-WAN connection. A suitable one must be selected by considering the following two points:

1) LAN-WAN connecting unit
2) WAN type

This paper analyzes LAN-WAN connection from the various points of view by considering actual examples or by using simulation.

2. LAN-WAN CONNECTING UNIT

By taking up actual examples, this section introduces the various LAN-WAN connecting unit types and indicates how to select an optimum one.
They can be classified into two major categories, these dedicated to LAN-WAN connection and those having other functions as well. Each category includes units having different features. Table 1 classifies the LAN-WAN connecting unit.

Table 1 Classification of LAN-WAN connecting unit

Major category	Minor category	Feature
LAN-WAN non-dedicated unit	Controller	Host system connection
	Server	OA server UNIX server
LAN-WAN dedicated unit	Bridge	protocol free
	Router	Preventing MAC broadcast
	Brouter	having both bridge and rou -ter function

3. LAN-WAN NON-DEDICATED CONNECTING UNITS

3.1 Server and Controller

This section introduces the LAN-WAN connecting units that are used for other purposes as well. The first purpose of this unit is for application systems, but it is also able to be used to connect LAN and WAN. This units are thus selected according to the application. The problem is whether the unit can be also used for the LAN-WAN connection.
As this kind of unit which can be used for the LAN-WAN connection, host system controllers, OA servers, and UNIX servers are treated in this section. These units are necessary for the host system connection or for the application, but can also be used as LAN-WAN connecting units.

3.2 Fujitsu Products

Table 2 lists Fujitsu products available as host system controllers, OA servers, and UNIX servers.

Table 2 Fujitsu products available for LAN-WAN connection

Classification	Product name
Dedicated host system controller	NMC
OA server	K series, FMR series, FMG series
UNIX server	A family, S family, DS90-7000 series

3.3 Product Functions and Examples of Use

1) Dedicated host system controller (NMC)

Dedicated host system controllers are used to communicate on behalf of terminals that do not have communications functions. NMC has various interface and is able to connect networks each other. Since the units are intended for host system connections, however, they permit only access to the host system. In a communication system centralized at a single host system, the units cost less than dedicated units such a router and bridge. Figure 2 shows a example of a LAN-WAN connection using NMC. NMC is placed at each office to control the terminals. The terminals and NMC are connected to the same Ethernet. The NMC is also connected to the host computer at the center through leased analog lines. If an office has many terminals, more than one NMC are placed.

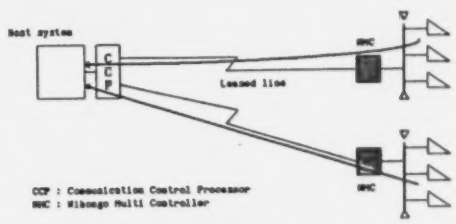

Figure 2 LAN-WAN connection using an NMC

2) OA server (K series, FMR series)

OA servers are efficient in the office as file and mail servers etc. Unlike the host system controllers, they process application programs independently. They must have terminal interfaces but do not always require host system interfaces. To communicate with the host system is additional function.

OA servers which have connection for host are convenient because the user can accessed hosts through them. Since dedicated machines are not necessary, costs are reduced. Figure 3 shows an example of using a Fujitsu FMR as an OA server and LAN-WAN connecting unit. The FMR is worked as an OA server by the LAN Manager software which runs under OS/2. Fujitsu provides a LAN manager for the FMR that also enables connection to Fujitsu's M series host computer. Terminals connected to the Ethernet can thus access the LAN manager on the FMR and also the M series host system through the FMR. This means that the FMR works as a LAN-WAN connecting unit as well.

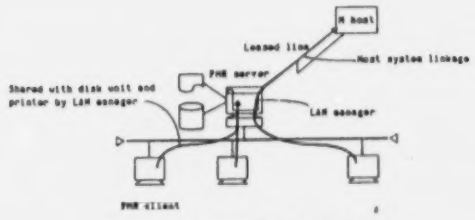

Figure 3 LAN-WAN connection using FMR machines

3) UNIX server

UNIX server may be used for Office Automation, but since the UNIX OS forms a certain field on LAN, the UNIX servers are explained here separately. UNIX machines can function as TCP/IP routers in most cases. So if the TCP/IP protocol is used, a UNIX server can be used as a router. However, it must be noted that application programs on the UNIX server may affect routing performance. The dedicated router and brouter explained in the next section are recommended if the performance becomes degraded or if a protocol other than TCP/IP must be used. In Figure 4, database software is worked on the UNIX server on the Ethernet connected with workstations. On the other hand, a UNIX server is also operated as a TCP/IP router to connect a workstation with a distant workstation on the LAN.

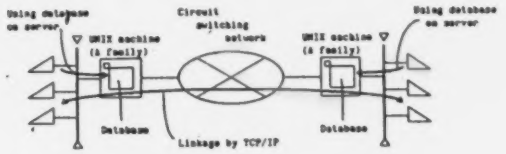

Figure 4 LAN-WAN connection using a UNIX server

4. LAN-WAN DEDICATED CONNECTING UNITS

4.1 Bridge, Router, and Brouter

This section introduces the dedicated LAN-WAN connecting units. The representative dedicated connecting units are bridge, router, and brouter. These units are connected not only for LAN-WAN connection but also for LAN-LAN connection. The units have different features and must be selected according to the conditions. Table 3 lists the advantages and disadvantages of bridges, routers, and brouters.

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Table 3 Bridge, router, and brouter function comparison

Item	Advantage	Disadvantage
Bridge	protocol free	Unable to block broadcasting packets
Router	Fault range localized by blocking broadcast packets	Available protocols limited
Brouter	Both bridge and router advantages	High cost

The LAN protocols can be classified into ones having layer 3 for routing and those having norouting layers. Following is examples of protocol which have routing layer or not.

- Protocols having routing layers
TCP/IP, OSI, XNS, IPX, DECnet, AppleTalk etc.

- Protocols having no routing layers
FNA, SNA, HNA etc.

Protocols having no routing layers cannot go through a connecting unit or and must be connected by a bridge.
Technically speaking, a router or brouter is desirable for protocols having routing layers. For LAN to LAN connection, however, a bridge is often selected because of easy maintenance or low cost.
For a LAN-WAN connection, router functions are more necessary than for a LAN to LAN connection. If a bridge is used for LAN-WAN connection and a fault occurs, the effect can spread all sites, and a broadcasting packet that cannot be interrupted may flow to WAN.
There are some practical cases that bridges are used to connect internal LAN and routers or brouters are used to connect LAN.

4.2 Fujitsu Products

Table 4 lists Fujitsu bridges and brouters available for LAN-WAN connection.

Table 4 Fujitsu bridges and brouters

Classification	Product name
Bridge	LLU
Brouter	LLU-E

4.3 Product Functions and Example of Use

1) LAN-WAN connection using Fujitsu LLU

Fujitsu supplies LLU as a bridge. Figure 5 shows an example of LAN-WAN connection using the LLU.
In this example, only the host system is connected and the FNA protocol which is not available to router functions is used. So the office LANs are connected by bridges (LLU). Since the LLUs have an FDDI interface, LLU and host system connected each other through FDDI and itcan resolve the traffic congestion at the hostside.

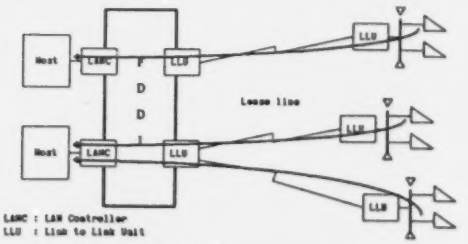

Figure 5 LAN-WAN connection using an LLU

2) LAN-WAN connection using Fujitsu LLU-E

Fujitsu supplies LLU-E as a brouter. Figure 6 shows an example of LAN-WAN connection using the LLU-E. The teminals are connected to the host system or workstation. Two protocols, FNA and TCP/IP are used. The systems use the brouter (LLU-E) which operates as a router for TCP-IP and a bridge for FNA.

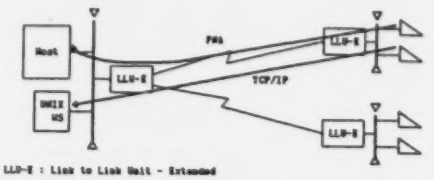

Figure 6 LAN-WAN connection using an LLU-E

4.4 LAN-WAN Connecting Unit Selection Method

The previous sections introduced the types andsome examples of LAN-WAN non-dedicated and dedicated connecting unit. Figure 7 shows the unit selection guide, explaining the proper selection method of non-dedicated and dedicated units. It is a general guide and may not apply in certain cases, such as the budget is not enough.
In Figure 7, if the path goes to the right after first dropping down through the left side, both server and routers are used. This happens quite often in the practical use. (See Figure 8)

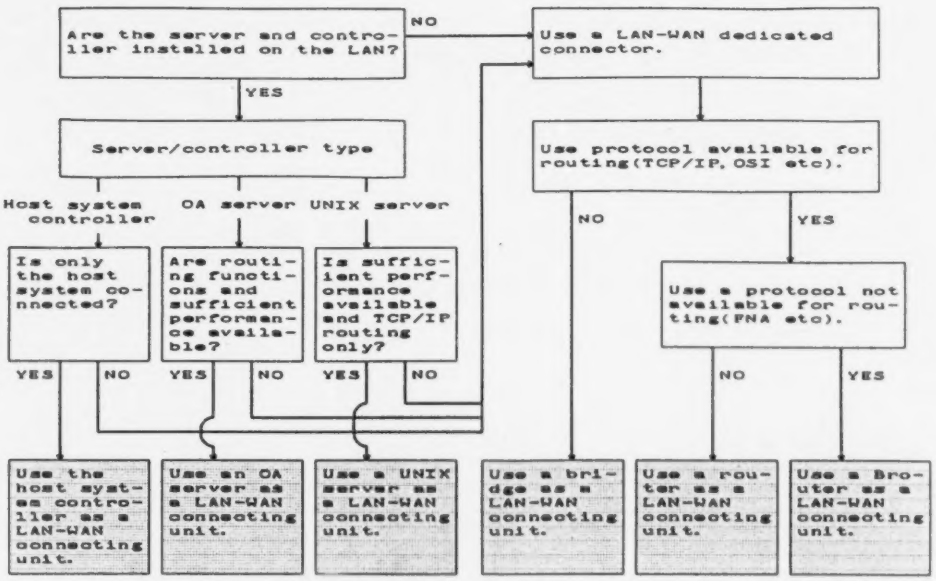
Are the server and controller installed on the LAN?
NO
Use a LAN-WAN dedicated connector.
YES
Server/controller type
Use protocol available for routing(TCP/IP, OSI etc).
Host system controller
OA server
UNIX server
NO
YES
Is only the host system connected?
Are routing functions and sufficient performance available?
Is sufficient performance available and TCP/IP routing only?
Use a protocol not available for routing(PNA etc).
YES
NO
YES
NO
YES
NO
NO
YES
Use the host system controller as a LAN-WAN connecting unit.
Use an OA server as a LAN-WAN connecting unit.
Use a UNIX server as a LAN-WAN connecting unit.
Use a bridge as a LAN-WAN connecting unit.
Use a router as a LAN-WAN connecting unit.
Use a Brouter as a LAN-WAN connecting unit.

Figure 7 LAN-WAN connecting unit selection flow

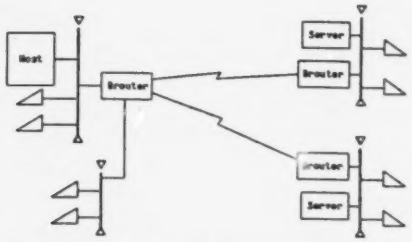

Figure 8 LAN-WAN connection using servers and brouters

5. THE KINDS OF WAN CONNECTING LAN

This section introduces the types of WAN connecting LAN, referring to the WAN application ranges. WAN are classified into following three types, leased line, line switching, and packet switching. They are evaluated in terms of traffic and speed.

5.1 Traffic

Costs is most important factor when selecting WAN. The costs are mainly determined by the distance between two sites and traffic occurence. Here, the relationship between the traffic and network costs is explained.
For LAN-WAN connection, traffic are sent together from a connecting unit. However, since there are several sources, the traffic shows a leveled distribution unlike for point-to-point connection. Considering the traffic tendency, leased lines are generally suitable for WANs connecting LANs.

To show it more concretely, example case between Tokyo and Osaka is used, which indicate relation between the number of terminals on LAN and a suitable network. Figure 9 shows the graph representing the relationship. The more terminals there are the wider the leased line area.

In LAN-WAN connection, the traffic distribution on the LAN varies with the overlapping of traffic from the terminals. Figure 9 shows border between circuit switching and leased line by dotted line in the case of extreme case. The right-hand dotted line shows each terminal traffics completely overlapped. Since the traffic on the WAN is the same as for a single terminal, the circuit switching range is rather wide.

The left-hand dotted line shows border between circuit switching and leased line when the traffic from the terminals is not overlapped at all. This is equal to when the terminals are connected separately to the WAN. In this case , since the time when circuit switching is used cannot be shared, the circuit switching range is small. The solid line indicates the border between the circuit switching and leased line areas set by simulating the actual conditions of use. The simulation almost revealed the same tendency as when the terminal traffic was not overlapped at all.
That is , LAN-WAN connections do not produce the advantage of sharing the time used by circuit switching. In this way, if many terminals share one connecting unit such as LAN-WAN connection, the leased line application range is very large.

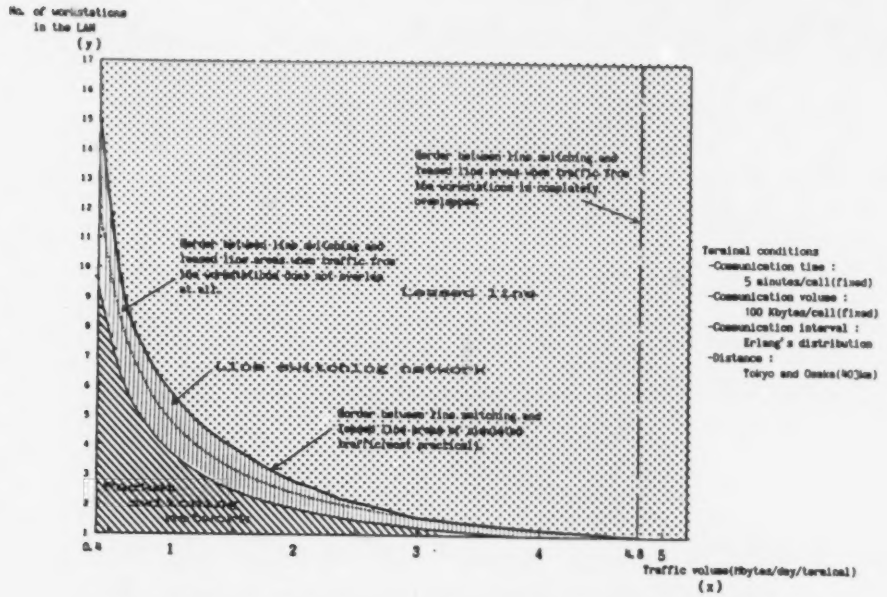

Figure 9 Relationship between the number of workstations in the LAN and the line application range

5.2 Speed

Speed is an important factor in a network , but especially WAN speed in a LAN-WAN connection is more important, because LAN speed is much faster than the WAN speed. Leased line and circuit line can realize the rather high performance , but packet switching is particularly troublesome because of the slow throughput. Especially, if the system must bundle only one character at a time like telnet, packet network is not suitable for LAN-WAN connection because of the low communication efficiency.
Packet switching, however, is superior to other networks in reliability.

5.3 WAN Selection in LAN-WAN Connection

Leased lines are less expensive and have better response for WAN connecting LAN.
But, since the packet switching and line switching have also their advantages, selection should be made according to the conditions.
Table 5 lists the evaluation of WAN in LAN-WAN connection.

Table 5 The evaluation of WAN in LAN-WAN connection

	Circuit switching	Packet switching	Leased line
Response	○	△	○
Cost	△	△	○
Reliability	△	○	△

6. CONCLUSION

This paper discussed various types of LAN-WAN connection from the aspects of LAN-WAN connecting unit and WAN types.
A selection guide and many LAN-WAN connecting examples have been given to help aid in the selection of a connecting unit for actual LAN-WAN connection.
For WAN selection, cost was evaluated by considering the traffic characteristics of LAN-WAN connection. This WANs selection guide is useful when selecting a WAN for a LAN-WAN connection.
It is further subject to consider much faster LAN such as FDDI, FDDI-Ⅱ and much faster WAN such as frame relay etc. It is expected to evaluate these new network in the near future.

SWITCHING OF A REQUEST TOWARDS A DESTINATION ADDRESS ACCORDING TO ITS SEMANTIC CONTENTS

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ABSTRACT

An intelligent network is able to switch a request in a network without knowing first its destination address. We propose to insert a new layer between the transport and the network layers, whose role would be to deduce the destination address of the request according to its parameters and the available services on the network.

INTRODUCTION

Until now in networks, the actors are well-known before the initial set-up of the connection. At the time of the call, the sender provides all the necessary data, and notably the destination address, to reach the remote correspondent. The network layer, as defined in the ISO 7-layers model, knows perfectly the configuration of the physical network.

The semantic transfer networks, also called intelligent networks, constitute a new approach of networks (1). The knowledge of the network's architecture is no longer a constraint. At the time of the interaction, the correspondent is unknown : the network itself must deduce the destination address, that is to say the most appropriate correspondent, according to the semantic contents of the request. So the network appears as a logical entity, which puts a set of resources and services at the user's disposal. This set of resources can evolve dynamically during the session.

The aim of this study is to define a method allowing to locate on the network the working-station to which the request must be sent. A comparison can be done with a cross-domain : such a network's configuration allows users to send their requests without having to know which machine will perform them. However, in a cross-domain, the localization of each application is well-known.

In the first section, we present the context of our study and particularly the integration of the new localization service into the layered OSI model. In the second section, we define the method used to determine a destination address. A bureautic application which implements this function is described in the third section.

I. PRESENTATION OF THE LOCALIZATION SERVICE

I.1. CONTEXT OF THE STUDY

I.1.1. Definitions

In this paper, we define a site as a node to which one or more working-stations are connected. In the following, we consider that every communication between two remote entities is in fact a communication between two working-stations located on two different sites. The figure 1 represents the context of this study.
Each site is addressable by a unique address, and as far as each site is able to deduce the destination address of a request according to its contents, the network can be qualified as an intelligent network.

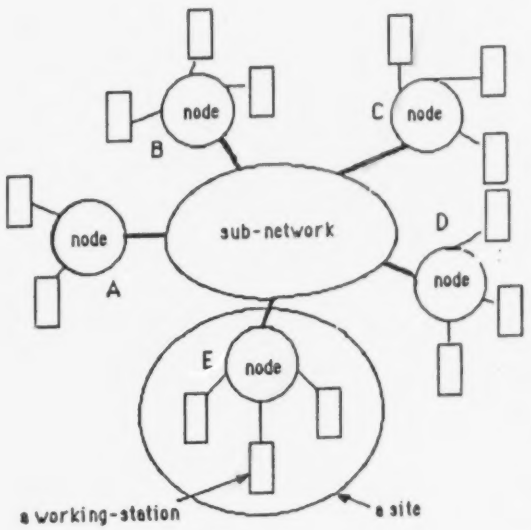

FIG. 1 : SITES LINKED BY A MULTICONNECTION NETWORK

I.1.2. Hypothesis

One of the major objectives for intelligent network is the independence of services towards the network's architecture (2). The proposed localization service is based on the concept of logical network. Therefore the topology of the physical network must not be a constraint or a determining information in the localization algorithm.

In order to facilitate the model of the localization service, at first, we consider that we are in an off-connection mode. The transport service and the network service will use only off-connection primitives as a datagram service.

At last, our aim is to modify the least possible the OSI model while integrating in this layered model a new service : the **localization service**.

1.2. INTEGRATION OF THE LOCALIZATION SERVICE IN THE OSI MODEL

In the proposed model, the user does not have to specify the destination address. So, as the request arrives in the transport layer, the remote correspondent is not still known. In the previous hypothesis (§ 1.1.2), we specified that the lower layers (1 to 3) of the ISO model were not modified. Therefore, a destination address must be provided to the network layer in order to define the routing of the request. That is the subject of our study.
Then it appears necessary to **add a new layer** between the transport and the network layers : the **localization layer** or layer 3' (Fig. 2).

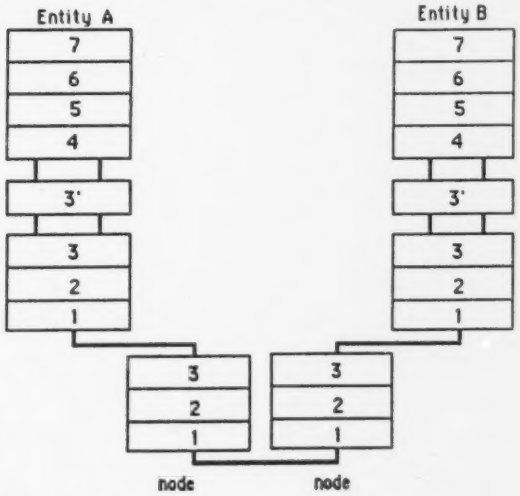

FIG. 2 : THE LOCALIZATION LAYER IN THE OSI MODEL

The localization function forms the subject of a whole layer for two reasons :
- it is wholly independent on one hand of the transport service which ensures the end-to-end connection, and on the other hand it is also independent of the network layer which realizes the routing.
- its function is to provide a service to the transport layer, while relying on the service provided by the network layer. That corresponds to the client-server model of interaction between two adjacent layers of the OSI model (3).

1.3. MODEL OF THE LOCALIZATION SERVICE

The transport layer sends to the localization layer a request without any destination address. So the localization layer defines this destination address with the localization algorithm presented in section II. This address is then transmitted to the network layer which can therefore route the request through the network.

When the destination working-station, which has been considered as the most liable to realize the expected service, receives the request, three cases can appear :
- the working-station can perform the requested service : then it sends a message to the initiator indicating that it will take charge of the request.
- the working-station cannot perform the requested service, a new destination address is chosen and the request is anew directed towards a new working-station.
- the working-station cannot perform the requested service but the request cannot be directed towards a new working-station (no other working-station can perform the expected service; the request is not allowed to travel anew on the network ..). The request's switching is so aborted.

The behaviour of both communicating entities has been represented by a linking of primitives. We propose to associate **L_LOCAL primitives** with the localization layer. The figure 3 shows the linking of the primitives between three sites. The site A is the initiator of the request. As the site B cannot realize the expected service, the request is redirected towards the site C, which will perform the service. So the site C returns to the initiator a primitive indicating that the request will be executed on its site.
The figure 3 gives the linking of the primitives used by the localization layer.
Note : there is no L_LOCAL.ind or L_LOCAL.conf which comes back to the transport layer of the initiator entity because we said that we were in an off-connection context. In this context, the initiator entity is not informed about the path followed by its request or even if the message has been delivered or not to a remote entity.

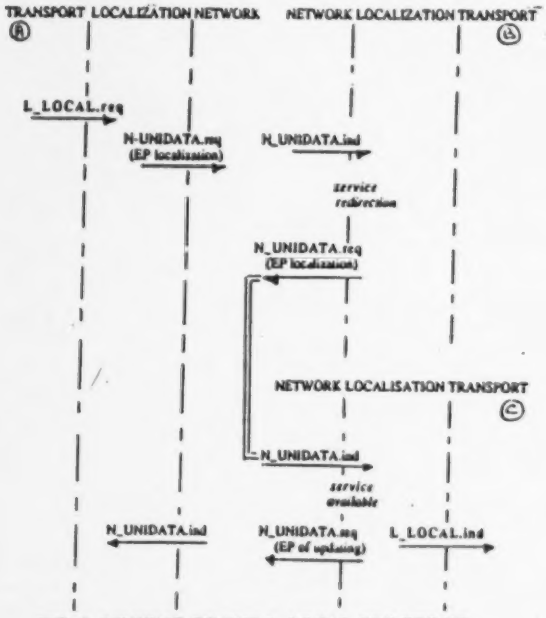

FIG. 3: LINKING OF THE L_LOCAL PRIMITIVES

II. THE LOCALIZATION ALGORITHM

II.1. RECEIPT OF A REQUEST

When a working-station receives a request, it examines its contents (that is to say, it makes the semantic analysis of its contents) in order to know if the requested service can be performed on its local site or not.
- If the service can be performed on the local site, as the request is satisfied, the remote correspondent address is returned to the caller.
- If the service cannot be performed on the site, the working-station checks if the request is allowed to travel anew on the network (every request contains a "chains-counter" : this counter avoids the request to circle indefinitely on the network. Each time the request comes in a working-station, this counter is decremented):
  -- if the "chains-counter" is > 0 : implementation of the localization algorithm and possibly redirection of the request towards another working-station.
  -- if the "chains-counter" is = 0 : abortion of the request's switching.

A working-station (and in the future a node of the network) must be able to calculate a destination address (Fig. 4). It does it according to :
- the contents of the request itself
- the knowledge it owns on the network (it is not knowledge about the network topology seeing that the localization function must be independent of it).

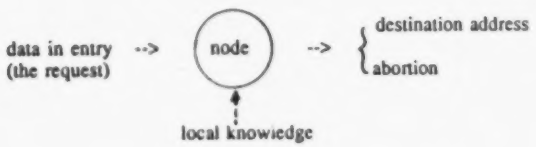

FIG. 4 : DATA USED FOR THE DESTINATION ADRRESS CALCULUS

II.2. THE ADDRESS CALCULUS PARAMETERS

II.2.1. Data in entry

- **the service itself**

- **the type of the expected service** : the available services on the network are gathered in classes according to their function or their domain of use. This classification is necessary for two reasons :
  -- it allows to codify the contents of the request. By this way, the switching of the request is done according to the type of the requested service. The semantic analysis of the request is not necessary to determine the next destination address.
  -- this classification allows also to generate a matrix on the local knowledge of the network (cf II.2.2).

- **the minimum threshold of switching** : the switching of a request is done according to the probability to find the sought-after type of service on one working-station. The user can specify a minimum threshold of switching. So only the working-stations which have a probability to own the requested type of service superior to the specified threshold will be taken in account at the time of the determination of the new destination address.

- **the list of the already reached working-stations** : in order not to come back to a working-station which has already treated the request, the list of these working-stations is added in the parameters of the request. Any new destination address will have to be excluded from this list.

II.2.2. The local knowledge

- **the list of the reachable working-stations** : in order to take in account only the active working-stations at the very instant t of the address determination, the working-station which must redirect the request broadcasts on the network the message 'ES_TU_LA'. The responses of the working-stations which have intercepted this message allow to generate the vector of the reachable working-stations at this very instant.

- **the matrix of the local knowledge** : this matrix CL is (n*m) sized (n: number of listed types; m : maximum number of working-stations connected to the network). Each item CL(i,j) contains the percentage of services of type i available on the working-station j in comparison with the whole number of services of this given type on all the network.

$$CL(i,j) = \frac{\text{nb of services of type i on the station j}}{\text{nb of services of type i on all the network}} * 100$$

II.3. THE DESTINATION ADDRESS CALCULUS

The working-station which must direct the request toward another destination uses the localization algorithm to find, within the reachable working-stations, which one is the most liable to perform the requested service.

Let consider :
- **m** : the maximum number of working-stations connected to the network

- **n** : the number of listed types

- **K** : the type of the requested service (1 < K < n)

- **S** : the minimum threshold of switching (10 < S < 100)

- **SC** : vector of the already reached working-stations. It is a boolean vector.

$$SC_i \quad i = 1..m \quad \begin{cases} 0 & \text{if the working-station has already treated the request} \\ 1 & \text{else} \end{cases}$$

- **SA** : vector of the reachable working-stations at the very instant t. It is a boolean vector.

$$SA_i \quad i = 1..m \quad \begin{cases} 1 & \text{if the working-station is reachable} \\ 0 & \text{else} \end{cases}$$

- **CL** : matrix about the network knowledge (distribution of the different types of services on the network).
$0 < CL_{i,j} < 100 \quad i = 1..n;\ j = 1..m$
The line $CL_{K,j}$ of this matrix is used to calculate the resulting vector.

The result is the vector R calculated as follows :

$$R_j = E\left[\frac{SC_j + SA_j}{2}\right] \circledcirc MIN\left[E\left[\frac{CL_{K,j}}{S}\right], 1\right] \circledcirc CL_{K,j} \qquad j = 1..m$$

The $\circledcirc$ operator is the logical multiplication term by term between two vectors (4).
R is a vector of percentage.

The destination address is so $ADR = i$
as $R_i = Max\ (R_j)$ for $j = 1..m$

Three cases can appear for the value of ADR :
- $ADR = 0$: no working-station can perform the expected service under the specified constraints. So the switching is aborted.
- if many values of R_j are equal to the maximum. That means that more than one working-station can perform the service. In that case, either a choice is made by the user, or new criteria of selection are added and the algorithm is anew executed.
- if there is only one maximum in R, the request will be directed toward this working-station.

The constraints (the list of the reachable working-stations, the list of the not still solicited working-stations), taken into account in this model to determine the destination address, are the minimum constraints. It is possible to add other constraints as :
- the access right to a working-station for a user
- the load of the working-stations in order to balance the load of the machines on all the network (5).

III. THE BUREAUTIC APPLICATION

III.1. CONTEXT : A LOCAL NETWORK

The network which has been used as a model for the implementation of the localization service is a local network, on which eight working-stations of type PC, at the most can be connected. A bus topology has been chosen, while the medium access is done through the CSMA/CD protocol. This bureautic oriented local network allows the user to send requets (as a file transfer or an express message sending) without having to leave its application or to save its work. From the user point, it is a multi-task system on single-task machines (6).

The architecture implemented on each working-station is as follows :

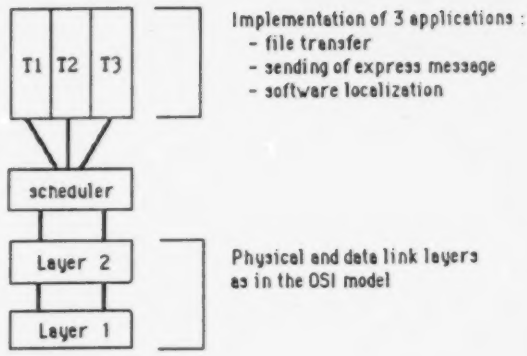

FIG.5: THE LOCALIZATION FUNCTION USED ON A LOCAL NETWORK

III. 2. THE APPLICATION OF SOFTWARE LOCALIZATION

This application uses the localization service in order to locate a software on the network. For example, a user who is looking for the Kermit software questions the network with the request : ' Où_est KERMIT'.
The implementation of this application needs the classification of the software available on the network, according to their function.

III.2.1. The software classification

The localization algorithm presented in section II is based on a local knowledge of the network. In this application, the useful knowledge is the distribution of the software on the network. So as, the software are gathered in ten classes according to their function (fig 6).
This classification allows to generate the matrix of the local knowledge CL. Each item CL(i,j) (i=1..8, j=1..10) gives the percentage of software of type i available on the working-station j, in comparison with the whole set of software of this type on all the network.

FIG. 5 : CLASSIFICATION OF THE AVAILABLE SOFTWARE

III.2.2. Switching of the request

When the request must de directed to another working-station, the research of the new destination address is made in two steps.

• Research of the reachable machines :
The working-station, which must redirect the request, broadcasts the message 'ES_TU_LA' in order to know which working-stations are connected at this very instant. At the same time, a time-out is set, beyond which the working-stations which have not

sent their response will not be taken in account to determine the future destination address.
The connected working-stations which receive the message 'ES_TU_LA' use the file transfer application to return informations about their configuration. In order not to exceed the time-out allowed for the response, the configuration files have priority. The queue of the files to transfer is managed according to this preemptive right.

When the watch-dog is off, the vector of the reachable working-stations can be generated.

* Determining of the destination address
The algorithm presented in section II is then executed to determine the destination address according to the type of the expected service, the global distribution of the software on the network, the list of the reachable machines, and according to the path already followed by the request.

III.3. LIMITS OF THIS MODEL. EVOLUTION TO A LARGER SIZE MODEL

The localization application implemented on this local network store all the data necessary for the localization algorithm and particularly the local knowledge matrix in data files. The use of a distributed database did not seem really useful in this context. Nevertheless on a larger size network, the implementation of a multi-database would facilitate the update of this matrix which is implemented on every working-station (7). The inter-base requests wich are implemented in the multi-database are particularly useful for the update , as far as : *"A n interbase request is an inter-base flow of data contrary to the classical requests which express a flow between the external world and the database. An inter-base request allows to update one or several databases called 'targets' with the data selected from one or several database called 'sources' "* (8).

CONCLUSION

A new approach of networks consists in considering the network as a logical network, that is to say a set of resources and services. In this context, giving the destination address is no more a necessity. The request's switching towards the working-station able to perform the expected service is determined according to its contents. A classification of the different kinds of services available on the network is used in order to have at one's disposal a global knowledge of the network. This knowledge allows to determine which working-station could possibly realize the expected service. The localization function has been implemented on a local network dedicated to bureautic in order to locate a software.

After this first step in our research, we will lead our work in two ways : first it consists in implementing this localization function on a set of interconnected networks (9). In that case, searching for the destination address means, on the one hand finding the network on wich one working-station owns the expected service, and on the other hand, finding in this network the working-station itself. The implementation of the localization on such a configuration would need the use of a database.

The second way of research consists in finding a really intelligent routing based on the semantic contents and not on a codification of it. That means the localization layer should perform a semantic analysis of the request.

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SYNCHRONIZING THE EVOLVING NETWORK

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ABSTRACT

This paper outlines the issues surrounding the present method of master-slave network synchronization, analyzes the impact of the evolving network, and discusses the stability requirements of clock systems to maintain timing performance. Solutions are offered with alternative methods of synchronization operation for the emerging problems associated with timing an evolving network.

1. INTRODUCTION

New technologies are placing an increased demand on telecommunications network synchronization performance. These networks are becoming homogenized to the point where the traditional physical boundary can no longer be readily identified. Mid-span meets of fiber optical facilities utilizing SDH/SONET technologies carry vast amounts of valuable digital information. As the network evolves, SDH/SONET equipment will create digital synchronous islands that require connection to the existing asynchronous network. The originator, intermediate carriers, and terminator of digital information must be synchronized to common, highly-stable, clock sources to ensure complete connectivity and performance objectives.

Achieving precise timing in the telecommunications environment is not a trivial task. Transmitting the timing from node to node has been the inherent problem for all digital networks. Traditional network equipment used to transfer network synchronization, such as digital switching systems, adds impairments to the once-traceable signal. As the synchronization signals are passed from node to node they lose their identity by passing through intervening clocks.

Timing will be an integrated part of all new network deployments. New transmission methods, network topologies and the issues they bring with them necessitate a review of current network synchronization strategies. Challenges that face the network are itemized. Although this paper studies the North American hierarchy, the principles and issues highlighted apply equally to any digital network. It will be demonstrated why distributed primary reference sources in every office and the BITS architecture is a technically and economically viable solution to the issues facing network planners today.

2. BACKGROUND

The evolution of the current digital network has created many timing challenges. The majority of these issues have been solved with hierarchical synchronization and a master-slave timing distribution network. It is necessary to understand the issues that have arisen as a result of the networks growth before the impact of future network strategies can be analyzed. Many of the challenges that were present before will be present again in this evolving network.

2.1 Digital Networks and Synchronization Requirements

In digital networks, all information —whether speech, data, graphics, or video— is coded using discrete, identical pulses. The distinguishing feature of the pulses in a DS1 data stream is their position and relationship to other pulses in time; this allows them to carry meaningful information. All transmitting and receiving network elements (NE) must be kept in precise synchronization to insure that the digital bits are encoded and recovered correctly to accurately represent the information they carry.

Two types of synchronization are required in digital networks. Frequency, or bit, synchronization ensures that the transmitting and receiving equipment operates at the same speed or data rate. Phase, or byte, synchronization establishes the position of a digital word (byte), time slot or frame. DS0 channels (unlike DS1) do not carry framing markers and therefore byte synchronization is provided externally. Both types of synchronization are employed in the network, which allows digital connectivity and facilitates reliable, error-free service.

2.2 Network Timing

Over the years, a synchronization hierarchy has been established with clocks segregated into performance or stratum levels [1]. Timing signals are ultimately traceable to a single clock referred to as the stratum 1 or primary reference source (PRS). The stratum 1 clock, being the highest quality and most stable source, feeds stratum 2 clocks throughout the network and transmits synchronization to other stratum 2 and stratum 3 entities. Similarly, stratum 3 clocks feed other stratum 3s. Stratum 1 responsibility is frequently provided by an interexchange carrier (IXC) —a holdover from the pre-divestiture days in N. America. Stratum 2 clocks are typically located at nodes or access points in a network. Stratum 3 clocks are the least accurate timing sources in the public switched network but are the most commonly used clocks in central offices [2]. Typically, the timing between central offices is conveniently embedded in a message-carrying DS1 facility where the equipment operates in a master-slave mode. Thus, a tree-like architecture is established (Figure 1) with a stratum 1 at the base of the trunk, with stratum 2s at forks of major limbs, and stratum 3 clocks at the extremities.

2.3 Equipment Timing

The Building Integrated Timing Supply (BITS) concept is the preferred method of distributing phase and frequency

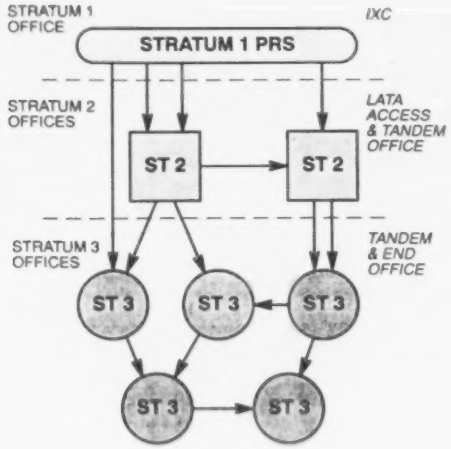


FIGURE 1. Traditional synchronization hierarchy of three performance levels.

synchronization within an office. The BITS clock is usually a stand-alone clock and is referred to as a Timing Signal Generator (TSG) or Digital Clock Distributor (DCD) [3]. For a "true" BITS architecture, the DCD is not a part of any network element (Figure 2). The advantages of a DCD is that its characteristics are designed solely for timing and are not compromised by other functions.

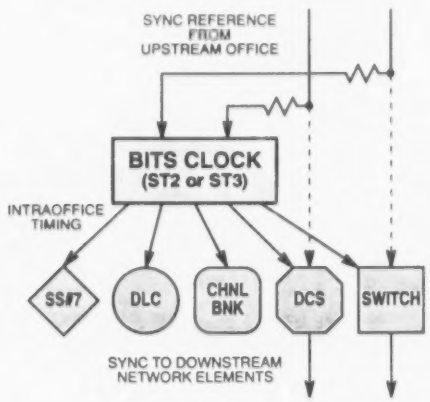


FIGURE 2. Building Integrated Timing Supply (BITS) synchronizes all central office equipment from a single clock system.

The benefits of using the BITS concept are generally found in three areas:

- Increased performance.
- Reduced administration.
- Maximum utilization of resources.

The fact that BITS is location-dependent rather than service-dependent (that is, synchronization is not a function of switching or facilities but a core support service) makes installation and maintenance considerably easier as new digital services are introduced [4]. A BITS also serves to filter a certain amount of perturbations from the timing signal before it's used to synchronize NEs and downstream offices. Ideally, BITS timing should be classified in the same manner as "battery and ground" –it's there when you need it, where you need it.

2.4 New Technology

SONET and SDH is the new digital transport protocol using a synchronous optical network [5,6], promises unrestricted high-quality digital bandwidth from 64 kb/s to over 13 Gb/s, and improvements in "operations, administration, maintenance and provisioning" (OAM&P) functions of the network. Another important aspect is the end-to-end compatibility of terminals. SONET adds powerful access and testing capabilities to a network of terminals and add-drop multiplexers (ADM).

Synchronous mapping schemes are used in SONET which allow individual DS0, DS1 and higher bit rate channels to be "visible" within a SONET signal. This is unlike the asynchronous multiplexing method used today. A 1.544-Mb/s DS1 signal is mapped into a synchronous payload envelope (SPE) within the synchronous transport signal (STS-n) by means of "pointers" (Figure 3) and other additional overhead information. A pointer is used like a "dynamic framing bit" to indicate the start of the SPE or "virtual tributary" (VT-SPE or VT1.5 for a DS1 signal) within the STS-*n* signal. This substantially reduces the transmission delay normally encountered with frame buffers in an asynchronous multiplexer. Because of the synchronous mapping function of SONET, DS1 signals appear to float within the SPE. STS blocks are then combined to form higher rates (STS-*n*) where they are converted to the optical carrier (OC-*n*) on the fiber optic "cable" or light-guide.

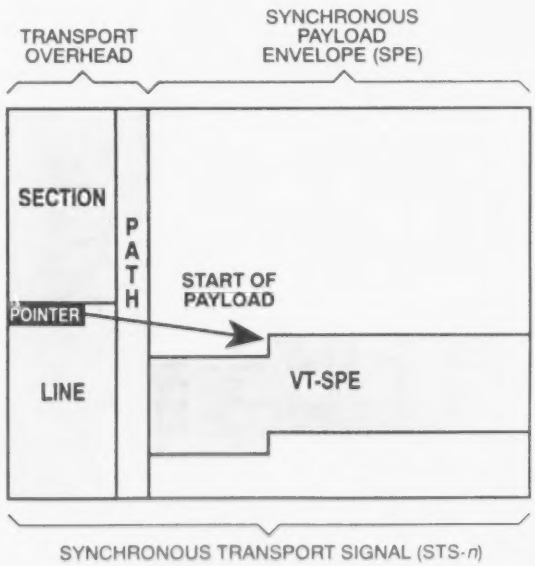


FIGURE 3. The use of pointers to map synchronous payload envelopes within the SONET structure makes DS1 signals float with clock differences.

2.4 *Synchronization Issues*

Current network synchronization issues are basically divided into four categories:

- Intervening clocks add inaccuracies and instabilities.
- Network elements designed for other purposes are employed to distribute timing.
- Specifications for synchronization are evolving and not widely understood by the industry.
- New technologies and topologies create additional problems.

These will be discussed in the following text and presented as a forerunner to the impact of newer networking issues.

Synchronization distribution is linked closely with the structure and topology of the current network where the routing of interoffice feeds are well constrained. However, timing transfer performance of NEs has been, within certain bounds, fairly loose and not (adequately) specified by industry standards below observation periods of 1,800 seconds which is characterized as wander (Figure 4). Frequency jitter, until now, has been the only other synchronization impairment specified in the time domain.

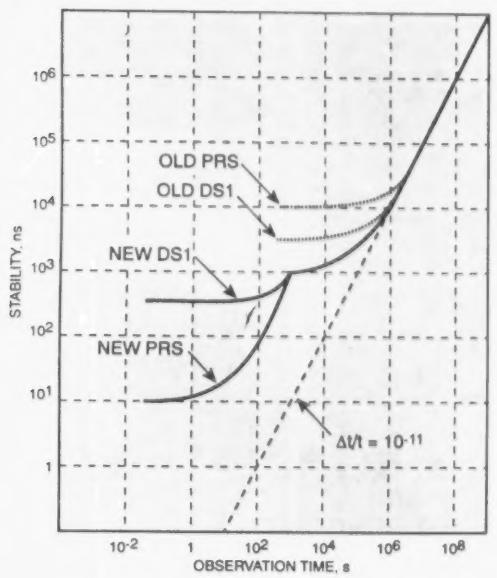


FIGURE 4. Timing stability as defined by T1.101. "New" requirements are contained in the draft revision to this standard (T1X1.3/90-026R6).

As the synchronization reference signal passes from node to node and on to the lowest level in the "food chain", intervening clocks and the transmission medium itself contribute to timing inaccuracy and instability [7]. Long-term variations such as wander are cumulative resulting in poor stability below the 1,800 second range. Although the BITS clock provides timing to the equipment within a central office, it is rare that BITS directly feeds the downstream network. NEs, such as digital cross-connects and digital switching systems, are employed to perform the distribution function (Figure 2). These NEs, as stated earlier, are not specifically designed to transfer timing and therefore add instabilities to the timing signal by the "breathing" effects of their intervening clocks and related system architectures.

To date, the characteristics of the reference as it passes through the network and the resulting impact on network performance are still being analyzed. Many timing issues manifest themselves downstream of the originating problem and are difficult to locate since there are many transients that occur. Upgrades to software and hardware have, and will, introduce additional troubles which are difficult to pinpoint. These troubles will also be present in a SONET based network. Work continues within the T1X1 [8] standards body to provide satisfactory and more detailed specifications for the undefined portion of the synchronization signal (Figure 4). A draft document has been drawn that will supersede the current ANSI T1.101-1987 synchronization interface standard. In this document the short-term stability has been defined. However, the new standards document is not released.

The rush to plug the holes in the synchronization standard is being fueled by the new technology and trial deployment of SONET. SONET, as its name implies, relies heavily on synchronization. Therefore, the stability of its timing source directly reflects its performance. This is also true when SONET is used to transfer timing. The "timing" output of a SONET NE is a function of its input plus any inherent effects from the NE.

Digital NEs (such as DCS and switches etc.) are being offered with integrated SONET transport functions or the promise of upgrades. Most of these existing NEs are currently used to distribute the timing throughout the network. With the introduction of SONET, the entire topology of today's network is being reevaluated. The OAM&P function of SONET will allow the network to be configured for self-healing and automatic reconfiguration by the use of diverse-routing, dual-homing hubs and ring architectures, analogous to "Olympic rings" (Figure 5). While this strategy will potentially aid the long-term integrity of the network, it may actually lower the reliability of synchronization by adding complexity and administrative problems to the timing distribution. No longer will the network be configured in a well constrained hierarchy.

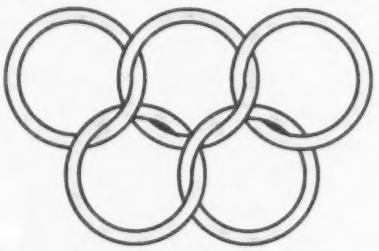


FIGURE 5. As the network evolves. a ring-like structure will be built resembling the "Olympic Rings".

Some network providers have chosen to establish dedicated timing links from node to node via asynchronous NEs which directly connect BITS clocks to BITS clocks at downstream offices. This is, however, a short-term work-around that allows SONET to coexist with the current network by removing

the burden of timing distribution from the SONET transport equipment.

Clearly, the adoption of SONET will have a widespread impact on the current network synchronization distribution plan and place an increased demand on a BITS clock. The increased demand will be a major challenge to insure the transport of synchronization from node-to-node while maintaining stability and traceability to a PRS. The performance of the network (and timing) already suffers from the timing problems introduced by switching and transmission equipment.

3. CHALLENGES IN THE EVOLVING NETWORK

SONET perhaps has the greatest impact on network performance. It potentially brings enhanced digital service offerings and powerful networking capabilities. But with this vast improvement comes a synchronization penalty. The major challenge presented to equipment manufacturers and network planners is how to put the "S" (synchronization) in SONET. Many of these synchronization challenges are common to all digital networks. However, SONET brings several unique issues of its own:

- SONET is a "synchronous" system vs. todays asynchronous network.
- Standards are "understudy" for SONET synchronization.
- VT interfaces with existing NEs and asynchronous networks.
- Existing NEs upgrading to SONET need performance characterization.
- Intelligent networks and rerouting add complexity to the network.
- Added complexity of the network creates administrative issues.
- NEs that distribute timing are intervening clocks.
- SONET adds new requirements on BITS performance and capacity.
- BITS is not widely deployed where SONET will be used.

Synchronization plays an extremely important role in the performance and networking of SONET. Timing variations of DS1 signals entering a SONET terminal will be quantized into 8 unit interval (UI) steps (8 bit periods of a DS1). These appear on the output side of the SONET transport system as 8 UI phase steps created by the mapping function of the pointers (Figure 6). DS3 signals mapped into the STS-*n* will undergo similar phase hits due to timing variations. The rate that the pointer adjustments (8 UI phase steps) occur per day will depend on the relative clock offset of each SONET terminal in the network. Recent studies [9] have shown that the mean time between pointers (MTBP) could be as little as 13 seconds. The resulting effect of these pointer created-phase steps has still to be evaluated in a functioning networked SONET.

Any time a DS1 (intended to distribute timing) is passed through a SONET NE, it will be subject to the phase steps caused by pointer adjustments. The 8 UI pointer justification on DS1s amounts to approximately 2.8 microseconds phase change and may be a significant impairment. DS1s embedded in DS3s before passing through a SONET transport system will also have the 8 UI phase step. But since the DS3 isrunning at a much higher bit rate, an 8 UI transient at 45 Mb/s will be in the order of 160 nanoseconds (or 1/4 of a bit at DS1) and will not greatly affect the embedded DS1's performance. However, once a DS1 or DS3 is mapped into a SONET transport system, it is difficult to control its routing through an integrated network of cross-connects and add-drop multiplexers. Because of the potential for rerouting, it is impossible to differentiate a DS1 suitable for network timing from one that is not.

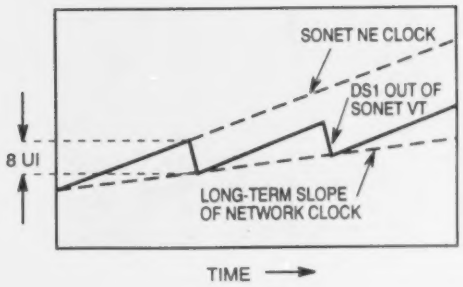


FIGURE 6. DS1 output of SONET VT1.5 signals will have periodic 8 UI phase steps or pointer adjustments.

One potential solution recommended by Bellcore [10] is to provide a method of using the optical line rate (OC-*n*) of SONET as a synchronization medium. To allow the evolution of SONET based timing distribution, NEs in central office applications should provide the capability to time the BITS by providing a DS1 reference derived from the ON-*n* carrier (Figure 7). Each SONET NE will use "timing only" ports (DS1s) from the collocated BITS to time its internal clock and clock the OC-*n* carrier. The receiving SONET NE will then directly convert the OC-*n* line rate to a pair of timing DS1 ports to be used by the local BITS as the reference signal.

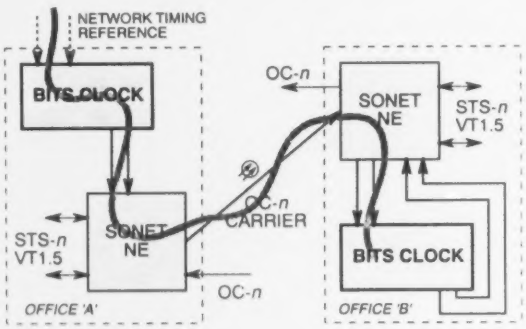


FIGURE 7. Timing distribution via OC-n carrier of a SONET transport system, BITS-to-BITS.

OC-*n* based timing is offered due to its immunity to facility rearrangements. It is not subjected to the phase steps resulting from pointer justification and has transparency from source to sink. However, this is a very simplistic view of transporting synchronization via SONET and does not address the complex network topologies in which SONET will be used.

3.1 SONET Network Complexities

In a network environment, when timing is carried via the OC-*n*, each SONET NE will regenerate the OC-*n* signal under control of the NE internal clock and pass that signal to

downstream NEs. Therefore, timing characteristics can be expected to accumulate toward a maximum allowable limit as the timing is passed from office to office. The internal clocks of some NEs in service today (which are planned to be upgraded to SONET transport systems) exhibit excessive short-term timing instabilities and/or do not meet the current stratum clock specifications. Using OC-*n* timing will require each NE to be evaluated on a case-by-case basis before including it in the timing plan. SONET ADMs will also use internal (intervening) clocks to regenerate timing and pass it to the next, downstream, ADM. The internal clock must, therefore, meet the new stringent (understudy) short-term stability requirements.

The adoption of a survivable network by the use of SONET rings, route diversity and automatic reconfiguration places an additional requirement on the SONET NE and BITS clock. Intelligence must be provided that determines the derivation of the timing source, whether it is suitable as a reference, and whether or not a choice should be made to search for other possible timing sources (other OC-*n* links, diverse network feeds or holdover). Selection and administration of reconfigured paths —suitable for timing references— becomes very complex. This scenario is commonly classified as *the network from hell*. Each network configuration and the various failure modes associated with it require analyzing and proof of performance certification before each new link and additional NE can be placed in service. This network model grows geometrically as links are added.

Synchronization messaging plays a key role in smart networks. As listed above, the NE must be able to identify viable timing links (Figure 8). A proposal is currently being discussed within the T1 standards bodies [11] that will assign a synchronization message or identity to the ESF data link of a T1 and allow this information to be mapped onto the SONET overhead structure. Generically the synchronization message will contain the source of timing and the status of the intermediate clock. This new standard is a formidable task since it requires all equipment vendors and network providers to work in consort to ratify the requirement. Until such time as a standard is worked out, each SONET vendor will utilize proprietary schemes to enable SONET networks to operate in all configurations. It will be difficult to dislodge a working method once a standard is issued.

Each SONET NE (and other new NEs) require a pair of DS1 timing-only feeds. These are to be provided by the BITS with a high-stability clock. Many large central offices have existing BITS architectures. However, in many cases BITS has not found its way into the smaller end offices; instead, they remain "loop timed". SONET and other new services will push the need for high-quality BITS at all offices due to the demand for a large number of stable timing sources. This is particularly true in the end-office environment where SONET based local feeder NEs are being deployed (Figure 9). These SONET "local" terminals will be expected to interconnect with switched digital services and other asynchronous transport systems.

Clock requirements for SONET are known to be extremely stringent. SONET vendors have expressed a need for signals with very tight short-term timing characteristics. The source for these signals will be via the BITS clock. Currently, the industry standards bodies (T1X1.3/.6) are actively negotiating applicable limits. These limits will be based on the effects

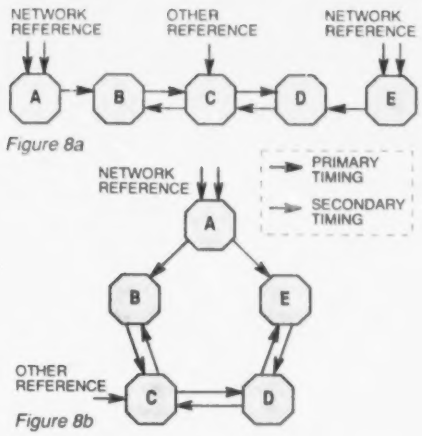


FIGURE 8. Synchronization messaging is required in this configuration so that each NE is capable of finding a valid reference. The linear network (8a) is considered as having identical issues as the ring (8b).

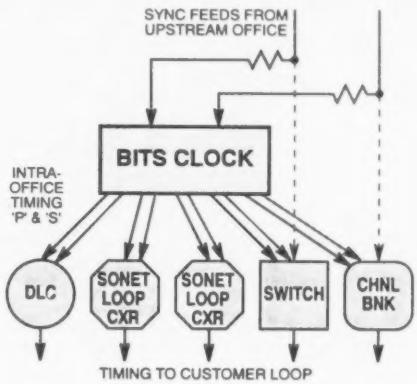


FIGURE 9. Additional BITS capacity will be requirements to time end-office SONET based local distribution.

of empirical data applied to a "SONET reference model". The BITS is therefore considered as a SONET timing filter. It will provide the very precise stability required by the NE to minimize pointer justification and assure the performance of the SONET-based network (Figure 10). Most stratum 2 based BITS clocks will meet the requirements proposed however tight the stability mask becomes, but the specifications must be known before any judgment is made on existing stratum 3 BITS clock compliance.

3.2 The Same Old Argument

SONET has now brought the network planner and synchronization coordinator full circle. The original arguments for adopting BITS in the mid 1980's has many of the same issues that SONET deployment brings today:

- Multiple timing feeds/choices.
- Network administration.
- Strain on office timing (BITS) performance and capacity.
- Effects of VTs on "end users".

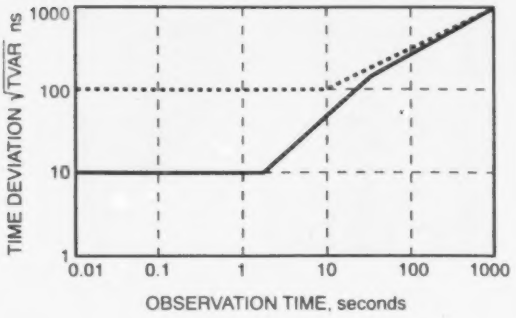


FIGURE 10. Short-term timing stability requirements for SONET. 10ns stability is required for NEs without timing filtering. 100ns stability is considered as the maximum allowable input.

Primarily, BITS reduced the number of timing feeds entering a building and provided a known clock source for uses throughout the central office. These two factors alone effectively eliminated the administration and operations burden that was in place before BITS. Now, due to SONET and other changes in network transport, the issues are confronting the network operator once more. In addition, the reference to the BITS may not be as constrained as in the past due to network reconfiguration capabilities of SONET and DCS-type architectures.

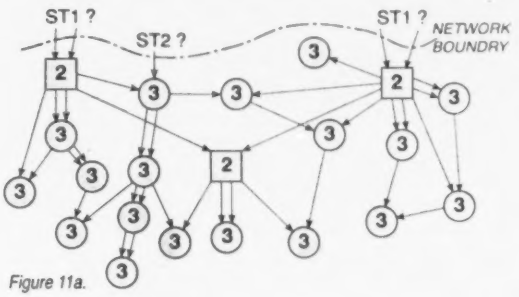
One solution to the network puzzle is not to rely on SONET for interoffice synchronization but to continue to use the existing asynchronous facilities. This strategy mandates that two independent networks are maintained. This may not be practical since most telephone companies are phasing in SONET-based transport systems that will "optically isolate" offices by replacing existing facilities.

One of the first uses for SONET-based transmission is in the local feeder area. Private networks which currently derive timing from a DS1 feed via the local LEC will have no control of the timing source and routing of these signals. Once the local network migrates to SONET, the potential of phase hits caused by the VT pointers may have an adverse effect on performance of the customer's network, and its ability to interconnect with other networks. The full impact of VT pointers on the customers synchronization is not known.

Smart networks are not limited to SONET architectures. 3/3 and 3/1 digital cross-connects can also provide the dynamic network reconfiguration, rings and route diversity that SONET offers. One problem that does arise in a total electronic office —where the manual DSX-1 has been replaced by the a DCS— is the fact that there is no physical access to a DS1 signal where the BITS clock extracts timing from the upstream node. This may be the case as existing offices are converted to "all digital" in an effort to reduce maintenance and operations.

4. DISTRIBUTED TIMING

The technologies available in the mid 1980s allowed the widespread, economical, adoption of BITS. However, this (existing synchronization plan) still relies upon the transport of timing from office to office and master-slave operation with its attendant problems. An alternative to transporting timing from the single PRS location to the far extremes of a network is to deploy distributed PRS clocks in every central office (Figure 11). Each site can be coordinated with UTC (UTC–universal coordinated time on the international time scale as maintained by the Bureau of International Weights and Measures, Paris, France) and operate plesiochronously with other PRS sites in the network much the same way interexchange carriers (IXC) do today.



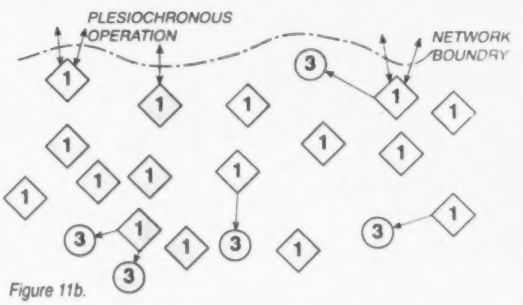


FIGURE 11. Distributed PRS sites remove the timing distribution network, administration and maintenance requirements. Links between networks will now operate plesiochronously.

The recent modernization of LORAN-C (a low-frequency radio-based navigation aid that covers most parts of the Northern Hemisphere) by the US Department of Transportation (DOT) and the initial deployment of Global Positioning System (GPS) satellites by the US Department of Defence (DOD) allows the recovery of a stratum 1 signal from the LORAN or GPS transmitter's cesium atomic clock ensemble by using low-cost radio receivers [12]. Both LORAN-C and GPS PRS BITS clocks can provide long-term stabilities in the range of parts in 10^{-12} (an equivalent slip rate measured in years), and short-term stabilities in nanoseconds, which is well within the requirement for a stratum 1 source and proposed SONET standards. The DOT and US Coast Guard has funding in place to maintain the LORAN-C system for civil users through the year 2010. A continuing modernization plan is underway that is upgrading each LORAN transmitter to fully automate the operation and coordination within 100 nanoseconds of UTC [13]. It is uncertain what policies cover the GPS system since it is military based and maintained by the DOD.

Distributed PRS or PRS in every office effectively eliminates the issues and problems encountered when timing is transported via SONET or via the asynchronous network. In this configuration, all NEs have access to the highly stable synchronization source that is now required (Figure 12). The payback from removing the need for interoffice synchronization administration and operation easily justifies the small initial expense of the distributed PRS clock equipment.

FIGURE 12. Loran-C transmitters are located throughout N. America and other Northern Hemisphere areas providing continuous 24 hour coverage.

4.1 Benefits of Distributed PRS

Several significant advantages are gained by embracing a distributed PRS architecture/BITS clock:

- The distributed PRS strategy is autonomous of network architecture and rearrangements and removes the requirement for timing distribution maintenance and administration.
- The network operation and performance is not compromised by slaving to an unknown source of an adjacent network.
- Distributed PRS insures quality timing, independent of the introduction and deployment of new technologies and topologies.
- Synchronization messaging is not required since there is no timing distribution.
- The BITS clock is engineered specifically for the best timing reference acquisition, generation and transfer qualities.
- BITS clocks can be upgraded or modified at any time without impacting major network elements.
- BITS clocks are free of design compromises and availability common in other NE clocks.
- Little or no timing network transport is required which mitigates intervening clocks in the timing chain. Only the BITS provides timing.
- Synchronization performance is enhanced due to the removal of timing distribution which generally is the main contributor to timing impairments.
- Cost of embedded clocks in NEs can be reduced since they are not required to transfer or distribute timing.

Clearly these factors cannot be ignored when analyzing the distributed PRS strategy. Moreover, by removing the transport element from timing distribution, the instabilities introduced by the facility transport elements are minimized to a point where they may not be a factor for SONET timing.

5. VERIFICATION

Since each node operates autonomously and interoffice links are now plesiochronous, a method of synchronization verification must be implemented. A synchronization monitor system (SMS) [14] derives a reference from the local PRS and uses this to compare outgoing and incoming facilities from other PRS nodes and networks (Figure 13). Performance limits assigned to each monitored point enable the user to verify synchronization performance remotely and take appropriate action before service problems occur. The benefits for the network operator of network-wide synchronization surveillance are:

- Survey adjacent PRS nodes and downstream office performance.
- Verify and compare incoming timing feeds.
- Compare timing from other networks and customers.
- Examine individual network element clocks.
- Monitor the timing distribution to remote offices and within the office.

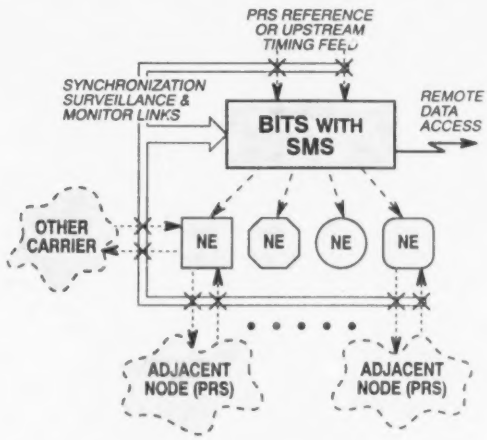


FIGURE 13. Synchronization Monitor System (SMS) verifies and assures the timing of the network.

Over time, a "picture" of the characteristics for each generic NE can be built. Through discriminating software, the network operator can classify and identify troubled equipment and network problems before they become performance or service issues.

6. SUMMARY

The implementation of BITS was a clear winner in the late 1980s. However, the network's ability to transfer timing effectively has remained as the roadblock to an ideal synchronization plan. SONET and SDH will exacerbate the already taxed office clocks by placing increased capacity and performance demands upon them. The robustness that SONET can provide to synchronization networking by using its optical carrier and self-healing/alternative routing schemes does, in fact, add complexity to the timing distribution.

The challenges of today's (and tomorrow's) network can be met technically and economically by the new approach of distributing the primary reference source function to every central office via LORAN-C. This removes the distribution issues entirely and ensures that all network elements receive precisely the same timing – all the time.

Verifying timing through a synchronization monitor system will play an increasingly important role. This coupled with a distributed architecture will facilitate a proactive maintenance philosophy and assure the synchronization control necessary for any new transport technology.

Distributed PRS will provide a new level of superior synchronization that has widespread benefits for all digital services and network performance in general. The distributed PRS/BITS architecture will provide the extremely stable timing required by SONET and SDH at its source without the issues of transporting timing throughout the network. This will provide the platform for future technologies and topologies to migrate into the network of tomorrow, today.

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Architecture for a Large-scale Digital Mobile Communications Network

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1. ABSTRACT

The architecture for constructing a new large-scale mobile communications network is described. This network is developed to meet the explosive increase in demand for mobile communications. Requirements for this network are also described, in particular, that it must be constructed at low cost and must be flexible and sophisticated enough to provide many inexpensive services for customers.

2. INTRODUCTION

In recent years, demand for mobile communications has increased significantly in many countries. In Japan, demand for portable telephones and car-mounted telephones is also growing by more than 50% a year. To meet future demand, it will be necessary to expand capacity, and improve flexibility and economy of mobile communications networks. On the other hand, the development of ISDN in fixed networks demands diversified and sophisticated requirements for mobile communications services. To satisfy these requirements and future demand, digital mobile communications networks are being constructed in numerous coutries.
This paper proposes the following items for large-scale mobile communications network architecture based on digital mobile technology NTT is currently developing.

1. A pursuit transit switching function to reduce large-scale network costs.
2. A multi-unit mobile-switch configuration in high density areas of mobile stations (MS).
3. Call control architecture with end-to-end signalling transfer capability to make mobile call control easier.
4. A concept of intelligent digital mobile communications network to enhance networ services.

3. BASIC CONFIGURATION OF THE MOBILE COMMUNICATIONS NETWORK

Generally a mobile communications network, where mobile stations move freely, has three logical functional mobile communications control centers to provide automatic roaming and automatic pursuit routing [1] .The basic configuration of a mobile communications network is shown in Fig. 1.

1. G-MCC - is the gateway switching center nearest the fixed network. It has a gateway function from the fixed network and a pursuit routing function using location information.
2. H-MCC - is the network data base center that stores information such as the location of mobile stations and subscriber class.
3. V-MCC - is the switching center where mobile terminals are practically roaming. It can connect call to radio equipment such as base stations (BS) and mobile stations.

At NTT, those three logical centers are connected by the CCS No.7 network and calls are controlled through it.

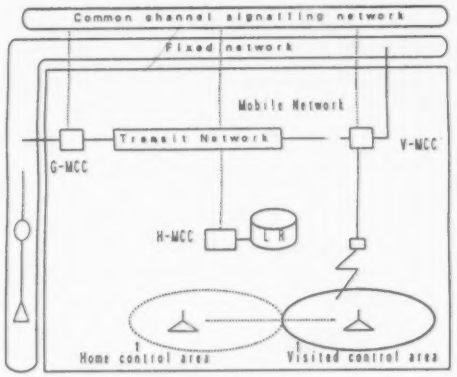

Fig.1 Basic Configuration of a Digital Mobile Communications Network

4. PURSUIT TRANSIT SWITCHING FUNCTION

In a mobile communications network with automatic pursuit routing, inter-office trunk lines between G-MCCs and to V-MCCs are needed to make calls. Also, inter-office trunk lines between V-MCCs are needed to perform handovers. If the network is small, as in the initial stage of a network, trunk lines between MCCs can be offered as a mesh. However, the larger the network, the more expensive the truck lines. As a result, transit switching for pursuit routing is necessary for efficient use of trunk lines between MCCs [1] .

In metropolitan areas where MCCs handle the large demand, each MCC has both G- and V-MCC functions. However, as shown in Fig. 2, it is inefficient to connect trunk lines from a fixed network to all MCCs. The network should instead be made physically hierarchical by concentrating the G-MCC function into some MCCs, as shown in Fig. 3. Comparing the non-concentrated (mesh) case with the concentrated one shown in Fig. 4, it is clear that the latter one is more economical than the former one. However, by introducing the concentrated G-MCC, it is necessary to incorporate the transit switching function (T) which transfers calls to target MCCs

in the mobile communications network. From the viewpoint of MCC capability, the T function should be combined with the G function and physically implemented in G-MCC. The G and T function in G-MCC is called pursuit transit switching function. Thus, to achieve a large-scale economical mobile communications network, a two-stage one [a gateway and transit stage (possessing G-MCC) and a subscriber stage(V-MCC)]is recommended, as shown in Fig. 5.

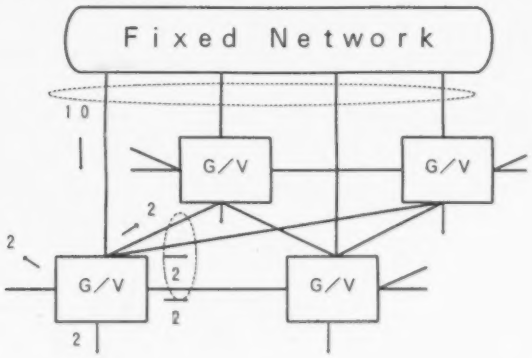

Fig. 2 Prime Mobile Network Configuration

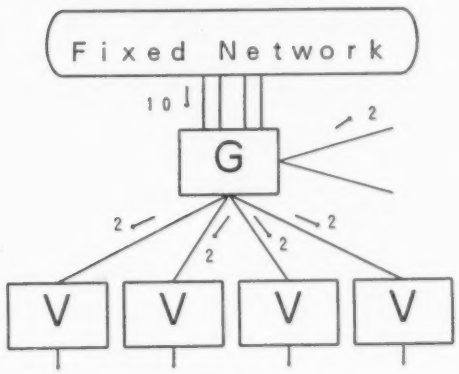

Fig. 3 Concentration of the G-MMC Function

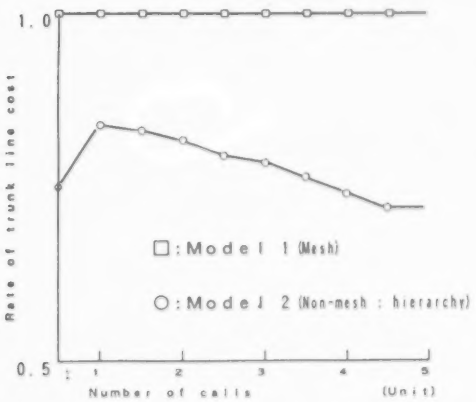

Fig. 4 Estimate of Trunk Line Cost

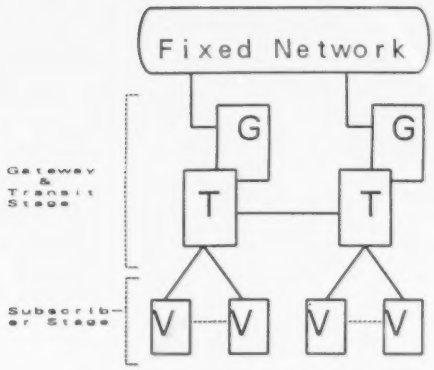

Fig. 5 Two-staged Mobile Network Configuration

In this mobile network, to guarantee personal mobility and terminal mobility, Personal Telecommunications Number (PTN) and Mobile Station Identity (MSI) must not correspond to any network resources such as MCC and location area. It must be a logical number independent of the network. Since the transit switching function can not route calls using dial information as in a fixed network, it is necessary to define the specified Pursuit Routing Number (PRN), for use only in the network, to physically identify each MCC. PRN usage is shown in Fig. 6. G-MCC can get MSI from PTN and it can also get location information for the mobile station and PRN of V-MCC. The transit network then routes the call to the V-MCC using the PRN.

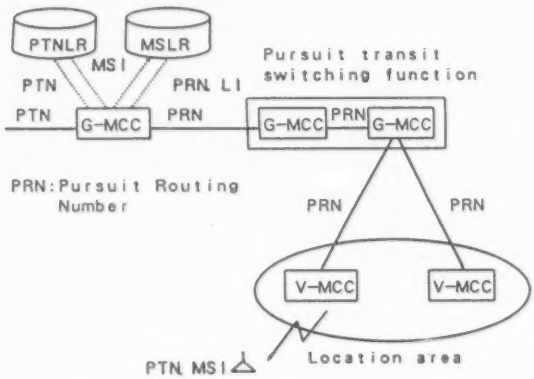

Fig. 6 Pursuit Transit Routing

5. MULTI-SWITCH SIMULTANEOUS PAGING (MSSP)

In the current mobile communications network, every radio zone is equipped with the mobile radio base station (MBS) and one location area has several radio zones, as shown in Fig. 7. The geographical position of the mobile station is identified by the location area. When the mobile station moves to another location area, it is necessary to update the location information in the H-MCC. A location area is synonymous with a paging area where mobile stations are simultaneously paged by the MCC when a call is made to a mobile station.

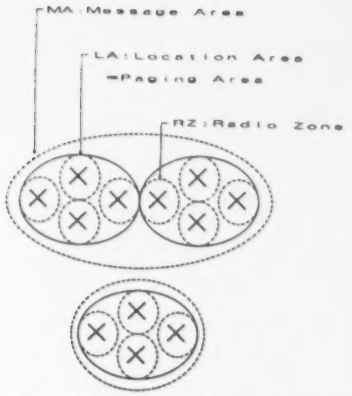

Fig. 7 Area Configuration of Mobile Communications Network

In the former network, a control area had several location areas, as shown in Fig. 9-(1). The number of location registration signals and paging signals varies depending on the size of the location area. In general, as location areas becomes smaller, the number of location registration signals increases because mobile stations cross location areas more frequently. On the other hand, the number of paging signals decreases because the number of MBSs sending paging signals decreases. Therefore, the most suitable size of a location area is determined independently of the number of mobile subscribers, as shown in Fig. 9. As described above, in the prime network which has a small number of mobile stations, a control area has one or several location areas. The control area can be large, as shown in Fig. 8-(1), but in a large-scale network where MS density is high due to increased demand, the control areas are smaller. If a location area has a number of control areas, as shown in Fig. 8-(2), the multi-switch simultaneous paging (MSSP) method[9] is necessary, as shown in Fig. 10 . In this configuration, several MCCs page the mobile station at the same time.

The following is an outline of MSSP. When the G-MCC receives a call at the mobile station, it routes the call to the V-MCC using the location information obtained from the H-MCC. Then, a random V-MCC routing method is applied in which the V-MCC connected to the G-MCC is randomly selected by the G-MCC. This method is most desirable because

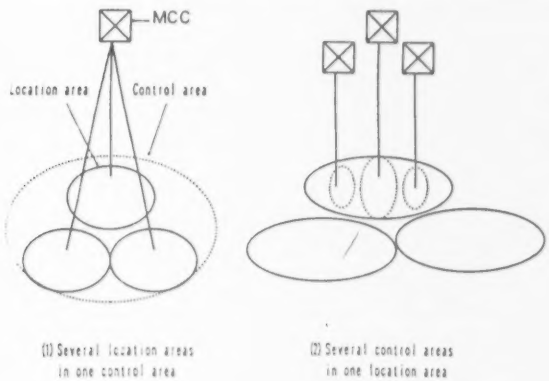
MCC
Location area
Control area
(1) Several location areas in one control area
(2) Several control areas in one location area

Fig. 8 Location Area and Control Area

mobile stations in control areas, except the control area of a failed V-MCC, can be paged even if a V-MCC system fails. As for setting up the trunk line between the V-MCCs, first, the trunk line between the G-MCC and V-MCC is set up. Next, the V-MCC sends a paging signal to other V-MCCs using a non-related circuit common channel signal and all V-MCCs page the target mobile station. The trunk line between the V-MCCs is complete once the mobile station answer signal is received.

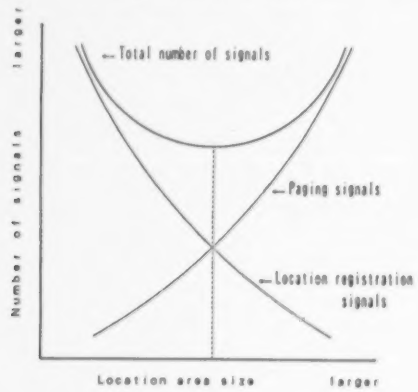

Fig. 9 Relationship between Area and Number of Control Signals

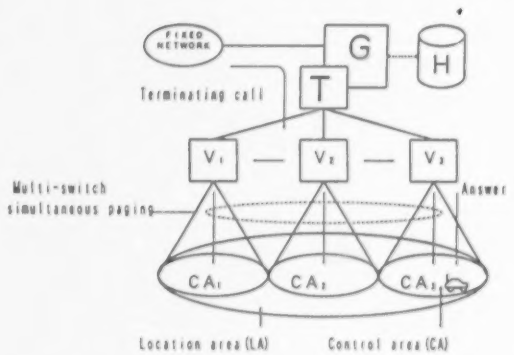

Fig. 10 Multi-Switch Simultaneous Paging

6. CALL CONTROL ARCHITECTURE WITH END-TO-END SIGNALLING TRANSFER CAPABILITY (CC-STC)

In mobile communications networks, the call control function is generally executed by V-MCC, which connects a traffic channel to a target MS. Therefore, when the MS roams from the source MCC to the destination MCC, as in inter-office handover, the call control function is transferred to the destination MCC, which then becomes the V-MCC.
As it will be necessary to expand mobile networks in the very near future, the following obstacles will be encountered.

1. Physical resources (e.g., call waiting trunk) to support supplementary services are fixed at the source MCC in basic handover. After handover, therefore, the destination MCC requires functions to control these resources.

2 If there are subsequent inter-office handovers, the trunk lines between the source MCC and the destination MCC, shown in Fig.11, is established each time. This makes trunk lines utilization ineffective.

3 If the call control function is transferred to the destination MCC in handover, data implicitly indicating the routing address to the call control MCC needs to be updated in a H-MCC. This is because a second call to the MSS must be routed to the destination MCC. If the second call is terminated before updating, the call is routed to the source MCC and cannot be processed.

To resolve these problems, call control architecture with end-to end signalling transfer capability (CC-STC) is proposed[4].
V-MCC functions can be divided into service control, handover control and radio channel interface. Independent of the target MSS's position, service control and handover control are fixed in one MCC, called an anchor MCC. During a call, the physical resources to support supplementary services are controlled only by the anchor MCC, which is the source MCC in basic handover, making it easy to control the resources. Trunk line use becomes efficient because lines are established between the anchor MCC and the destination MCC at every handover (Fig. 12). Furthermore, the call control function can be fixed to the anchor MCC, to route the second call to the anchor MCC (i.e. the source MCC in basic handover). This makes it unnecessary to update the data in a H-MCC.

To adopt this call control function, the V-MCC establishing the radio channel needs to transfer call control signals on the subscriber line from a mobile station or a mobile base station (MBS) to the anchor MCC. In this transferring of signals, the MSS or the MBS is one end point and the anchor MCC is the other. This method is therefore called call control architecture with end-to-end signalling transfer capability. The CC-STC can effectively control calls to offering advanced services similar to ISDN services.

7. INTELLIGENT DIGITAL MOBILE NETWORK (IDMN) ARCHITECTURE

As demand for mobile communications expands, the mobile communications network must be enhanced to offer services that customers really desire. Intelligent Digital Mobile Network (IDMN)[5] corresponding to Intelligent Network (IN) modeling is one way to enhance present mobile network.

The latest study defines the Intelligent Network (IN) model as a hierarchical configuration from the viewpoint of service control. It consists of the following levels:

1 Service Management Point (SMP)
SMP is a logical node in the upper part of the intelligent layer characterized by various functions such as service definition.

2 Service Control Point (SCP)
SCP is a logical node in the lower part of the intelligent layer. It directly controls the

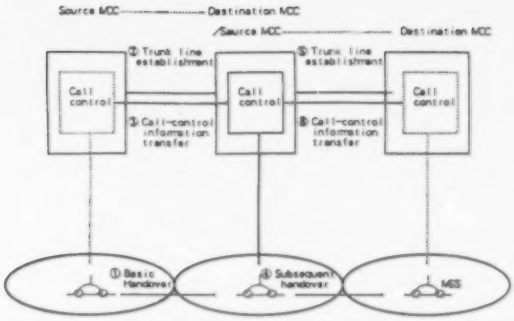

Fig.11 Call Control Transfer for Handover

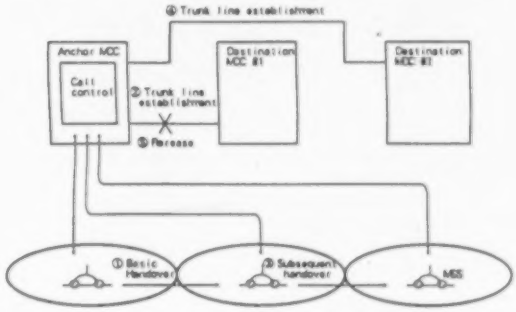

Fig.12 Transit Circuit Establishment in Handover with CC-STC

transport layer.

3 Service Switching Point (SSP)
SSP is a logical node in the transport layer. It provides the actual services.

When this model is applied to a mobile communications network, H-MCC (or Home Location Register (HLR)) corresponds to SCP because it guarantees mobility and also because it is a service control database directly controlling MCCs. Furthermore, because provision of customer-defined services in a mobile communications network will be mandatory, a logical node corresponding to SMP will be needed to enhance services. The intelligent layer should therefore be further divided into two sublayers.

The transport layer is defined as SSP in the IN hierarchical model from the viewpoint of control. G-MCC and V-MCC correspond to SSP. However, this layer should be divided into sublayers because it includes many call connection control functions in the mobile communications network.
G-MCC is located at the call originator side and it includes pursuit routing and call transit functions.
V-MCC mainly controls the base stations side Moreover, since these two logical nodes are located at different physical locations in terms of the call they should be defined as different sublayers. Furthermore, the radio frequency transmission control function, which is allocated to BSs, should be defined as another sublayer because it mainly depends on the radio transmission scheme.

A hierarchical IDMN architecture based on the above concept is shown in Fig. 13. From the viewpoint of service control, the intelligent layer consists of service management and network control sublayers. From the viewpoint of call connection control, the transport layer consists of pursuit routing, call control, and radio frequency control sublayers. The current mobile network should be enhanced according to this index from now on.

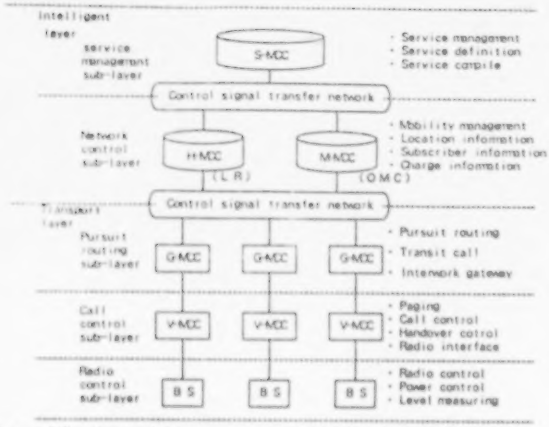

Fig. 13 Intelligent Mobile Communications Network Architecture

8. CONCLUSION

This paper described the architecture for a large-scale digital mobile communications network. Pursuit transit switching function, multi-switch simultaneous paging and call control architecture with end-to-end signaling transfer capability were specifically proposed, and the index for constructing an intelligent digital mobile communications network was also shown.

NTT is now developing digital mobile communications systems, applying the above architecture to construct a large-scale mobile communications network. The system will start gateway/transit-stage services in 1992 and subscriber-stage services in 1993.

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RURAL TELECOMUNICATION SERVICES IN MALAYSIA

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1. Abstract

Providing telecommunication services to rural areas, can facilitate many development activities including agriculture, industry, education, health, etc. Therefore, the planning of the telecommunication system for these remote areas is critically important. Malaysia has developed a good telecommunication infrastructure which can be extended to rural areas making telephone services possible to great many remote areas.

1. Introduction

It is quite clear from last decades that economic development of a nation goes hand in hand with development of communication resources. The importance of telecommunications in the economic development of the country and its relationship to increase productivity, efficiency and enhancement of the quality of life is well known. Both developing and developed countries require as many telecommunications tools as possible to deal with the diverse and difficult conditions they must face in bringing service to rural and remotes areas. By providing telecommunication services to rural areas, can facilitate many development activities including agriculture, industry, education, health, etc. Rural areas not linked to the telecommunications network are unable to fully participate in social and economic development programmes. The socio-economic benefits to be gained from the introduction of rural telecommunications are increased local employment, reduced transport cost, marketing will be more efficient, emergency services will be more readily available and reduced the sense of isolation.

2. Requirements For Rural Telecommunication Systems

In planning future telecommunication networks, consideration should first be given to the development of rural areas as an essential part of a harmonized evolution in a given country. Rural telecommunication planners should consider the latest technological advances and evaluate the possibility of their introduction in this part of the network.[1]

The rural network development in Malaysia started in 1957 with the introduction of two programmes namely Rural Payphones and Rural Automatic Exchanges. The rural payphones are public payphones installed under the "Rural Public Telephone Programme" started since 1959. Till 1987, a total of 6031 rural payphones had been approved costing Government an estimated sum of M$51.2 millions. The estimated cost of providing a rural telephone is M$15,000 per service in comparison to only M$3,000 in urban areas while maintenance is about 8 times that of its urban counterpart. All the rural payphones are strategically located so that they are readily accessable by the publics. However the exchanges in rural areas were mainly manual and the standard distribution plant was of aerial construction.

In Malaysia agricultural production continues to contribute a decreasing share of the economic output but provide employment for a large proportion of the population. Morever, the Malaysia's Industrial Master Plan has focused on resource-based industrialisation. However, agriculture is imposed with a main problem i.e. the low price of its products, most of which is sold in raw form. Information and knowledge have emerged as the critical strategic factors for growth, increased value-added and competativeness in the modern economic environment. Therefore by providing telecommunication services to rural areas will have significant long-term influence in lifting the agricultural sector from its present low quality, low productivity and low cost status. Telecommunications can improve efficiency and productivity by making price information available to farmers and helping in the timely delivery of products. It can also attract industry and allowing the decentralization of economic activities away from major cities. Furthermore, the creation of natural resources project in remote region can necessitate the urgent installation of few communication facilities.

Studies have demonstrated that rural telecommunication services play an important role interm of improving the socio-economic of a country such as:

(a) increasing the efficient use of existing infratructure to alleviate transport bottlenecks in the delivery of imports to agriculture, and promoting energy conversation;

(b) improving the operation of the market mechanism by extending access to information, encouraging more efficient marketing of agricultural products;

(c) improving the efficiency of government administration, including the coverage of advice and supervision by scarce middle and higher level technical and management personnel and reducing administrative bottlenecks and unneccesary travel;

(d) improving the delivery of healthcare and emergency services such as ambulance etc.

The normal evolution of telecommunication services start with major cities and highways linking them. The challenge facing is to provide the rural telecommunication services. However, there are several factors which pose immense obstacles to the development of telecommunication services in rural areas. To overcome the rural problems, we must understand the rural environment and take into account its characteristic. First is the distance where conventional cable transmission systems for long distance would be very expensive. Terrain and hostile topographical obstacles add futher difficulty where mountains, rivers, swamps and forest pose major problems for the development of telecommunication services. The climate is another potential problem. Heavy tropical rainfall and high humidity affects equipment and attenuates microwave signals. Electrical power supplies can be non-existent in rural areas. Due to the result of all these factors the cost of providing good telecommunication services to these network may low to begin with. However, good telecommunication services can themselves stimulate industrial and commercial growth.

There are a number of system options available for developing rural telecommunications wireline, single- channel radio, multiple access radio and cellular radio. These can be described as follows:

(a) Copper cables are being used to provide services to customers within the immediatel vicinity of up to 20km from the telephone exchange.

(b) Single channel system can provide a service to an individual customer located up to about 40km from a suitable entry point to the national network. This distance may be extended to about 80km if a repeater is used.

(c) Small capacity radio system, both existing analogue and digital, can provide links from the existing national network for variety of purposes. These include link to remotely sited telephone exchanges at small settelements or to provide dedicated circuits to high calling rate customers.

(d) Digital multiple access radio system become increasingly more usefull in more thinly populate,

inaccesible locations. Such a system is able to provide service to customers located up to 600km from a suitable entry point to the national network.

However, using the cellular network to penetrate these remote rural locations is probably the fastest way of reaching new subscribers. It can be as an integrated resource not just for mobile users, but also for widespread rural subscribers. Therefore a cellular mobile telephone network is a tremendous starting point for rural network development.

3. Cellular Radio Network in Malaysia

The world standard for cellular systems are currently operating in the frequency bands around 450MHz, 800MHz and 900MHz. The lower frequencies have better propogation properties, so they would be best suited to rural applications. Therefore cellular system operating at 450MHz is the most suitable frequency for rural network development with lower traffic capacity. However 800MHz and 900MHz are becoming the most common frequencies for cellular networks in urban areas. Furthermore, frequencies around 1.7GHz will be used for future Personal Communication networks (PCN).

The global growth of cellular telephony has turned it into a mass-market industry. Competitive pressures mean that technical developments will continue, and prices will continue to fall. This will make cellular techniques even more suitable for rural network development.

In Malaysia we have already got the cellular network infrastructure in place, so any new ways we can use it to represent only a marginal additional cost. In rural areas it is less costly to provide a cellular telephone than to lay special transmission line. Although Malaysia's industrialization is proceeding rapidly, especially in Kelang Valley area between Kuala Lumpur, the national capital, and the peninsula's west coast, the majority of the nation's land mass is still tropical forest land. The percentage of the population living in urban areas has indeed risen from 27% in 1970 to 34% in 1980, but many Malaysia's villages are in comparatively isolated areas many miles from the nearest town..Therefore the cellular system will provide basic telephone communications to many isolated areas where service using conventional distribution plant is expensive.

First Malaysia's cellular mobile telephone system is called ATUR, an acronym which stands for Automatic Telephone Using Radio It is based on Nordic Mobile system with (Radio Base Station) RBS and exchanges provided by Ericsson. The first phase of the ATUR system was put into service in January 1985 thereby establising Malaysia as the 13th country in the world having mobile cellular system. At the end of 1985 Malaysia became the first country in Asia with a fully automatic nationwide cellular mobile telephone system[1]. The use of 400MHz for the first phase of the system has provided almost natiowide coverage to 329,749 square kilometre country by only 86 RBS, most of which have a coverage area of about 30km. The highest station in the whole system is on Mt. Kinabalu in Sabah, 2231 meters above sea level. There also are stations in Malaysia on Kedah Peak at 1217 meter and Gunong Ulu Kali at 1772 meter. These high altitude stations serve larger areas than at lower sites.

For this system the country is divided into five service areas, each serve by one mobile exchange as shown in fig. 2. The mobile exchange are at Kuala lumpur, Penang, Johor, Sabah and Sarawak. Each of these areas acts as the home area for a mobile subscriber, and all calls addressed to such subscribers are directed first to the home exchange and then to the mobile. ATUR is specified according to the Nordic Mobile Telephone system standard NMT 450 using 180 channels with 26kHz separation in the frequency range 452 - 466.5 MHz.

A 900MHz cellular telephone system was put into services in 1988 to complement the ATUR 450 service. The service areas are mainly in major cities and towns in Malaysia. and is specified according to the TACS standard. Since ATUR system provide natiowide coverage which cover rural and remote areas therefore it is more suitable for providing rural telecommunication services.

One important thing that need to be considered is the cost of

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purchasing a cellular telephone. The price of cellular phone today is beyound the means of most people, especially the Asean countries. In rural areas we are talking about those poor farmers who earn just enough to buy the basic necessities of life. Having put up a cellular telephone telephone system for rural areas we cannot ask them to buy their own individual cellular telephones. The practical thing to do is to provide a phone that everybody can use but without imposing on them high cost of the cellular telephone i.e. a public phone which can be connected to the cellular system. Therefore we can plan for fixed cellular phones as the basis of rural telecommunication network.

4. Public Telephones

Malaysia poineers the concept of using the mobile telephone system to provide telephone service to rural areas via Coin Collecting Box (CCB) public telephones. A special radio interface unit was developed by Ericsson for Malaysia which makes it possible to connect the standard CCB telephone to the ATUR network and thereby eliminate the physical wire connection as shown in figure 3. Call fees from CCB telepnone are same as those from ordinary cable-fed pay phones, so there will be a substantial measure of cross- subsidization. Malaysia's poineering effort in this area has received world-wide recognition and we are very honoured that other developing countries are looking at "Malaysian Model" as a complementrary solution to their rural telecommunications needs.

Approximately 500 coinbox telephones in all states of Malaysia are in operation so far, under the control of Telekom Malaysia. The distance from the coinbox telephone to the radio unit can be up to 2 km. This gives the possibility of installing the antenna on a hill or on a nearby high building. Power comes from the main supply or from solar powered baterries. The transceiver is connected to a high gain YAGI antenna, so that the unit can be placed even further away from the Radio Base Station site. By using Yagi antenna at RBS the effective range can be increased. The coverage in rural areas can be further increased by using higher power at RBS with a consequent increase in effective range. Besides being used to provide the rural telecommunication services, fixed installations are also being used in urban areas in order to provide temporary network due to shortage of local cable and wire line exchange capacity.[3]

5. Satellite Systems for Rural Communications

If the areas with extended range cannot be reach, we can turn to satellite techniques and microwave point to point links which can be used in the cellular network strategy. Satellite transmission links between the mobile switching centre and RBS allows RBS to be installed virtually anywhere.

Furthermore, the use of satellite based solutions to overcome the technical and economic difficulties associated with expanding the public telephone network into the rural areas has been a subject of great interest. The outstanding advantage of satellite systems lies in the nature of their coverage, which also permits the establishment of a nation wide network.

6. Conclusion

In general rural telecommunications cannot produce sufficient revenue to recover capital and operational costs. As a result, a large gap can generally be seen in the number of telephones being installed in rural areas as compared with urban areas. Telephones in developing countries mainly concentrated in the major cities, leaving the majority of the popupation without access to the service. However, by making used of the existing cellular network infrastucture this problem could be overcome. The cellular network can play an important role in developing rural communications and lets rural communities benefit from a new communications resource that originally created for the business sector. The well-to-do users of mobile users can be happy in the knowledge that they are , in effect, making affordable telephone service possible to great many remote areas.

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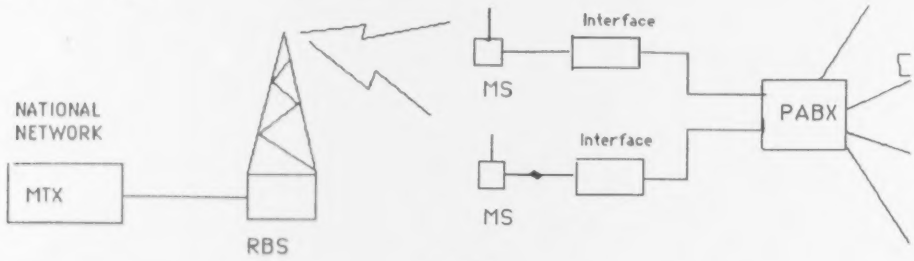

FIG. 1

FIG. 2

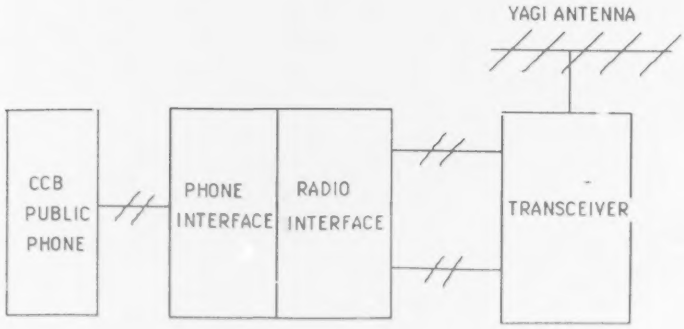

FIG. 3

Papua New Guinea Telecommunication Network Development

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1. ABSTRACT

Papua New Guinea (PNG) is large in size and population compared with other Pacific Island nations. With an economy based largely on mineral exports, telecommunication development in PNG has, over the years, centred on providing services to meet the mining industry's needs as well as other business organisations in urban PNG. In so doing, it has fulfilled the national government's objective to generate revenue in order to sustain growth and development. However, the second objective of extending services to most citizens remains to be fulfilled.

2. THE COUNTRY

Papua New Guinea (PNG) with a population of 3,529,539[1] and land area of 462,840 square kilometers is the largest of the developing nations in the South Pacific. The country comprises the mainland with 85% of total area and some 600 islands in the Bismarck and Solomon seas.

In the 1990 census, 85% of the national population were shown to live in rural[1] areas of PNG, and rely heavily on subsistence farming for their existence. The rural population growth rate is 1.7% with the urban 3.17% and national at 2.03% per annum.

PNG has 20 provinces with population figures given in table 1. Population density varies from 3 persons per square kilometre in coastal areas to 20 in the highlands region. The five highlands provinces; Chimbu, Enga, Eastern, Western and Southern Highlands have 37% of the total population.

No.	*Province Name*	*Capital*	*Population*
1	Western	Daru	108,705
2	Gulf	Kerema	68,060
3	Central	Port Moresby	104,584
4	National Capital Dist	Port Moresby	193,242
5	Milne Bay	Alotau	157,288
6	Northern	Popondetta	96,762
7	South Highlands	Mendi	302,724
8	Enga	Wabag	238,357
9	Western Highlands	Mt Hagen	291,090
10	Chimbu	Kundiawa	183,801
11	Eastern Highlands	Goroka	299,619
12	Morobe	Lae	363,535
13	Madang	Madang	270,299
14	East Sepik	Wewak	248,308
15	West Sepik	Vanimo	135,185
16	Manus	Lorengau	32,830
17	New Ireland	Kavieng	87,194
18	East New Britain	Rabaul	184,408
19	West New Britain	Kimbe	127,547
20	North Solomons	Arawa	*

*North Solomons census could not be taken due to political crisis during the 1990 census.

Table 1. Provinces, capitals and populations.

1 Rural population is defined as areas with a maximum of 500 and density of less than 195 persons per square kilometer and no urban services, e.g. water, electricity etc.

Rugged mountain terrains cover most of PNG, the remaining areas are swampy plains with very little flat land. Provision of telecommunications services to people in different parts of the country can be a very difficult task: not only must it be reliable and efficient, but it must also be economically sound.

The PNG economy is based mainly on agriculture, forestry and mineral exports. Foreign aid also helps supplement the national budget - Australian aid, which is the major source of foreign aid, has been decreasing at 5% per annum since 1986.

In 1988 coffee generated 9% of total exports while agriculture/forestry as a whole generated 28%. This left PNG excessively dependent on minerals. The closure of Bougainville copper mine in May 1989 and unfavourable mineral prices on the world market saw the growth in Gross Domestic Product (GDP), which had been 4.5% per annum from 1985 to 1988, drop to 3% in 1989 and is expected to decline further in 1990[2].

Increases in mining and exploration activities will result in corresponding increases in telecommunications needs: a very important requirement of mining industries. These needs are usually new radio links and terminals or increases in system capacity - exchanges capacities, radio bearers and so forth.

International traffic measured in paid minutes using Both Way Traffic (BWT) has increased on average by about 5% per annum since 1982. Most of the increases would be due to mining related activities. Table 2 gives some idea on the volume of international traffic (in paid minutes) between PNG and countries in other regions of the world. It is worth noting that traffic between PNG and South Pacific nations also show increases.

INMARSAT stations are a new development in the network. Since 1987, 4 stations have been installed and made operational, normally serving as standby or backup for part/total failure of the terrestrial networks. Over the years, failures have been due to human error, equipment malfunction - lightning strikes, flat batteries and individual component failure, or as is often the case, vandalism by landowners[2] demanding land compensation payments.

2 In PNG land is traditionally owned by the people.

COUNTRY	*1982*	*1984*	*1986*	*1988*	*1990*
Australia	12104348	12394556	13628397	17002000	22257065
Cook Islands	636	4300	4989	6707	8469
Fiji	50275	71174	86834	132175	230604
Kiribati	275	970	1435	7383	12438
New Zealand	618540	745540	844594	1129220	1420190
Solomon Is	69205	108225	95199	176760	315748
Vanuatu	8275	19840	21663	50730	66383
Hong Kong	205617	188852	254234	244016	437098
Indonesia	21346	29458	59985	74889	124382
Japan	137121	187428	267886	447663	509665
Phillipines	136253	134656	132101	216943	470686
Singapore	84784	136267	227388	608036	1263849
France	11017	19761	20457	52065	86551
United Kingdom	363913	608772	644423	642916	917999
USA AT&T	344007	477660	665487	915392	1300703
West Germany	35533	54976	90168	152263	230499
INMARSAT	0	0	0	5527	8867

Table 2. Both Way Traffic in Paid Minutes

2.1. Telecommunications

The national government's objectives in telecommunications are principally two-fold. First, that a good affordable quality of service be made available to as many people as possible and second, that the service be financially self supporting to continue improving the service for the people of PNG.

Entrusted with the task of fulfilling the government's objective is the Postal and Telecommunications Corporation (PTC). It has a workforce of just under 3000, 6% of which are non-citizens. This portion is likely to be maintained over the next five years, to provide training for national staff and expertise required for the operation and maintenance of the latest equipment in digital radio and satellite technology in the proposed network developments.

PTC was the only statutory organisation in PNG to return at least 16%[3] return on investment in 1990.

Annually since 1988, over 100 million Kina (K1 ≈ USD 1.03) in total revenue is generated by the Telecommunications Division of PTC. This amounts to 88% of total revenue for the Corporation. 67% of the deposition of revenue would be in operating overheads, labour and maintenance of mostly telecommunications related projects in urban areas.

3. PNG TELEPHONE NETWORK: AN OVERVIEW

3.1. Exchange Hierarchy

PNG telephone exchange hierarchy[4] has five levels[3]. The highest, level 1, is the international gateway exchange in Lae that provides switching for international traffic. Level 2 or the national transit exchange also in Lae caters for the switching of domestic traffic between two primary or level 3 exchanges. Seven primary exchanges make up level 3 and perform two functions: provides switching for a subscriber in direct local service areas of the primary - a level 4 function or acts as local transit exchanges for switching of traffic between any remote small local or level 5 exchanges. Level 4 exchanges comprise only 2 main local or stand alone exchanges. These have direct routes to exchanges of levels 1 to 4 and provide terminations of telephone lines in their service area. The lowest level, level 5, consists of 43 small local exchanges that provide terminations of telephone lines in their local service areas and are parented to a primary exchange. Level 5 exchanges can route calls to/from their own subscribers but calls to/from outside call area must be switched through higher order exchanges.

3.2. Radio Bearer

The difficult mountain terrain between major PNG towns makes communications possible only by use of radio. Frequencies in HF, VHF, UHF and SHF bands are used for different traffic requirements.

HF frequencies are used for low grade service rural outstation radios owned either by government or private organisations[5]. HF subscribers operate into manual assistance centres for access to the national network.

VHF/UHF band caters for small to medium[6] capacity systems with high grade of service offered to subscribers usually within coverage area of a primary exchange or repeaters with drop/insert facilities.

UHF/SHF or microwave bearers are large capacity and carry the bulk of network traffic, standard radio bearers between centres are of 960 channel capacity.

Given the geography of PNG, it is often necessary to use repeaters on mountain tops, at 1000 to 4000 metres accessible only by helicopter, to provide communications. With different manufactured equipment, operations of the radio bearer are either at 2 or 6 GHz. Some repeaters on the national network bearer have facilities for drop/insert of spur routes with some 300 channels capacity.

In 1988 a major network development was the replacement of radio bearer equipment on the main bearer linking Boroko, Lae, Goroka and Mt Hagen. The new equipment supplied by NEC provides two 960 channel telephone bearers (operating on a 1:1 redundancy), one spare 960 channel telephone bearer and a TV bearer which provides live TV transmission to the three centres from studios in Port Moresby. The NEC equipment, can be converted to a digital bearer with minor modifications.

Solar power is used in all repeater sites with battery banks having capacities designed to provide reliable supply in low sunlight conditions for durations of up to a week. Remote monitoring of repeater stations status conditions is possible using sub baseband (SBB) frequencies on the NEC equipped radio bearer.

The last of the bearers are the two troposcatter links, one from Madang to Lombrum, Manus province and the other from Cupola, Gulf province to Daru, Western province. It is possible to link Daru by microwave. Manus however is beyond line of sight distance, it will not be possible to replace this link with a microwave bearer.

3 PNG government return on investment required is 16-22% per annum.
4 Exchange statistics excludes North Solomons Provinces

5 In 1987 there were 1919 HF outstations, only 390 were government owned.
6 Small capacity have 20 or less channels, medium greater than 20 less than 120 and large capacity greater than 120 channels.

3.3. Telex Network

The current Electronic Telex Exchange (ELTEX) in Lae was installed in the seventies. It is driven by a PDP11 computer utilising Stored Programme Control (SPC). With the introduction of facsimile there has been a decrease in the number of telex subscribers and equipment annually. Subscribers from Port Moresby are linked to the ELTEX by a line concentrator at the Boroko exchange.

Telex utilises Voice Frequency Telegraph (VFT), Speech plus Data (S+Dx) and TDM to 'stack' telex channels on a single voice channel. Statistics to date show TDM channels to be increasing at the expense of VFT/S+Dx channels.

3.4. International Network

PNG is linked to the world firstly by a cable, APNG and secondly a INTELSAT B type earth station located at Port Moresby. Both of these were commissioned in 1985.

The APNG cable is from Port Moresby to Australia and has a capacity of 4 supergroups (SG) only 3 are used. The extra SG is for additional traffic from the earth station should there be a failure. International traffic for the cable is switched and designated (in the 960 channel or 16 SG bearer) from the AXE 103 exchange, in Lae. The cable has a design life of 15 years and it is anticipated that by then low capacity fibre optic technology would be available to replace APNG.

In June 1990 APNG circuits total 199: 186 voice, 1 non voice and 12 leased circuits. Only six countries had direct circuits to them with Australia having a total of 165.

Traffic to the Earth Station is also designated and switched from Lae. Voice activated Single Channel Per Carrier (SCPC) and Companded FDM (CFDM) techniques are employed on the space link to countries around the world. In June 1990, there were a total of 88 satellite circuits (46 SCPC, 42 CFDM) comprising 83 voice and 5 non voice to 13 countries around the world. Australia had 24 satellite circuits allocated.

With the AXE 103 digital exchange, International Direct Dial (IDD) is now available to nearly all subscribers in PNG. Apart from it's general switching role, the AXE 103 computer also performs management and house keeping functions resulting in vast improvement to the overall performance and efficiency of the national telecommunications network.

4. DEVELOPMENT PLANS

4.1. International Network

Scientific Atlanta has been awarded a contract to upgrade the current B class earth station to INTELSAT A. Intermediate Data Rate (IDR) will be introduced initially to Australia and thereafter to other countries with or intending to use IDR.

Two SG of the APNG cable will be digitised by 1992. At the end of it's design life (year 2001), APNG is likely to be replaced by an optical fibre cable.

Another international digital gateway exchange is planned for Port Moresby to ease congestion on the Port Moresby-Lae bearer and provide services not available from the analogue exchanges. Currently international traffic originating or terminating in Port Moresby goes to Lae first and then back to Port Moresby occupying twice the bearer capacity required if directly switched from Port Moresby.

4.2. Domestic Network

4.2.1. Domestic Satellite (DOMSAT)

Increasing land compensation demands and outage times on major bearers, due often to damage to repeaters, has caused inconvenience to subscribers and decreased revenue collection. This has forced PNG through PTC to proceed into satellite technology earlier than anticipated.

Scientific Atlanta, has again been contracted to build 13 fixed earth stations, in major towns around the country and 4 transportable mobile stations. A transponder from PALAPA B-2P satellite at 113°E will be used with the earth stations to provide a thin route telephony service, a number of 2MB/s digital carriers and a TV channel. The DOMSAT Hub station will be in Port Moresby.

The PALAPA lease will be for 3 years after that PACSTAR an Asian Pacific Regional Satellite System will provide the service. PNG has 20% share in PACSTAR.

Overall performance requirement of the 3 services: telephony, 2MB/s digital bearers and TV, will be governed by the INTELSAT Earth Station standards (IESS).

Initially, an interim DOMSAT scheme is planned to provide five earth stations, four of which would be used in mining towns and one by the government.

4.2.2. Other Planned Domestic Developments

All analogue exchanges and microwave radio bearers are scheduled to be replaced with digital ones. The main bearer between Port Moresby and Lae will be commissioned first.

Fibre optic cables will replace metropolitan junction cables in Port Moresby and then Lae.

PNG Packet Switch Network (PANGPAC) operates between Lae and Port Moresby. Growth in number of subscribers with increasing demands for use by centres other than the above two will see this service expand nationwide.

A data link using the INTELSAT BUSINESS SYSTEMS (IBS) satellite is to be installed in Lae.

4.2.3. Costs

Overall, the expected investment (in millions of Kina) for the planned developments are:

DOMSAT	13.5
INTERIM DOMSAT	2.9
DIGITAL UPGRADE	2.95
IBS	0.146

5. ACKNOWLEDGEMENTS

The author should like to acknowledge the help of K.Laeka, P.Loko of the PTC Engineering Division for information concerning the proposed developments, and Professor G.H.Bryant and the PNG University of Technology for making this paper possible.

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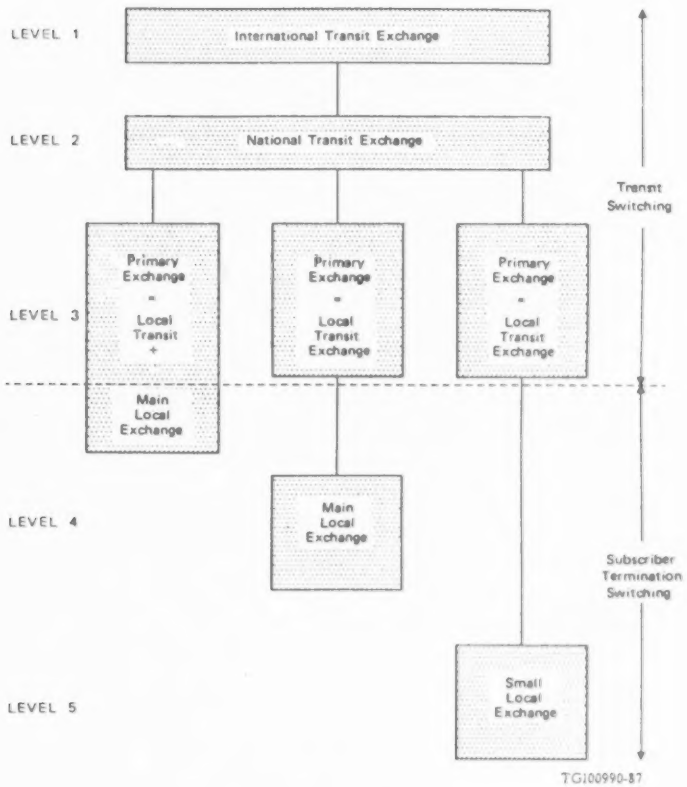

Hierarchy of exchanges in the PNG Network

Satellite "Cellular" Telecommunications User, my Experiences and Problems In a Mobile Society Improves the Pacific Hemis[illegible] Cultural Growth and Development

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1. ABSTRACT

Many Satellite "Cellular" Telecommunications users adheres to modern amenities benefits such as ISDN applications and the new concept "IRIDIUM" for the emergent behavioural needs in case of disasters/accidents and public safety is concerned. Also, the main concern of the Pacific Rim Telecommunity here is network Interconnecting by intermodal networking and local networking. The Satellite "Telenetworking" by cellular mobile systems has improved not only cultural growth and development in urban and remote areas it will definitely bridge technical, economic, political, social/cultural and spatial gaps in this 14th Pacific Telecommunications Conference.

For the Regional Interests and Global Issues as well as the Challenges of Telecommunications[1] Integrations for the Pacific.

2. Satellite "Cellular" Telecommunications[2] users.

2.1 Our real experiences and Technical Problems to Resolve on the Pacific Rim Telecommunity.

Satellite "Cellular" Telecommunications users will bring real benefits and generalized for the Large Area networking in the uses of the ISDN application for the Integrated Services Digital Networking. This will also improve the "Spectrum" management from the Pacific Rim Telecommunity for the Global networking in different countries. This has also improve the program management for ISDN applications users in Integrative networking, if we use the unified solution in regulatory basis. First of all, we should also consider the probable overlapping with other ground-receiving stations in the sense that non-regulatory is proceeded in the Pacific Rim Telecommunity. But Considerably the Global Telecommunications for Integrative results, then we have to go into a Telecommunicational consultative for "nodal" strategic locations and dispersives mobility of the Telecommunications needs of such countries whether small or big, underdevelop or developing countries. In regards with Pacific Rim Telecommunity we fairly believe[3] "Iridium" can be a resounding success as long as the two-way system is being program on the ISDN for Global networking and "Program" management is being centralized for dispersal of reliable and "true" information technology in relation to the effect and results for the formations of a roaming information for local mobile service areas.

2.2 Telecommunicational Mobility Improves the Pacific Rim Hemisphere [4]

Cultural Growth and Development

The Improvement now in Satellite "cellular" telecommunicating has brought about the bridging the gap of have and haves-not countries in the Pacific Rim Hemisphere cultural growth and developmental objectives. In my main areas of professional specialization "Remote Sensing" we are met by many difficult experiences and problems and we are raising it here in this scientific "fora" -- The compatibility of our needs/rights for the Pacific Rim Telecommunicality because of the lack of vital "amenities". In short, take this hypothetical "theory" to secure our satellite thematic "Mapping" data we make a computer search for our technical clearance record from a nearby "ground-receiving station." This would necessarily and uncomfortably take us longer than the time frame as set-up by our organization and our would be clients and service customers. This we think has ripen for us to take a bold step for the Pacific Rim Telecommunicality as well as for the people of Asia.

Now secondly, let me consider "IRIDIUM" is to make the Telecommunications with anyone at anytime --- no matter where they are --- a reality through the use of satellites. Using a handheld portable phone, callers will send signals to one of the low orbiting satellites, which will then send the signal back to the receiver's handset or on to another satellite. This would enhance Interconnectivity to emergent situations, events, places and localization on mobile systems. Now with the new capability of the "STAR" (Satellite Tracking and Reporting Sensor) which the EOSAT has provided for the answer of providing a 5 Meter High Resolution Remote Sensing Data.

This program is to fly a high resolution on Landsat Satellites.

A program of this type will combine satellite sensor, communication and data processing technologies in innovative ways to implement a new state-of-the-art information gathering capability. Now, with the STAR system the following services are possible:

1.0 Three color, 5 meter resolution images of any location in the world.

2.0 Coverage of any part of the world on a dail; basis.

3.0 Data delivered within hours of its collection for crisis situations.

4.0 A worlwide library of data.

5.0 Imagery custom-tailored to fit individual formats.

We formally believe at this juncture that our needs/rights for a Pacific Rim Telecommunicating capability here in Asia can only come into realization by installing or the installation of a Ground-Receiving station here in the Philippines such as and similar to that of Japan and Thailand.

- o transferring of calls to an operator assisted message services;
- o call transferring to a voice mail system;
- o immediate billing functions allowing temporary telephone users to be invoiced with no delay;
- o detailed billing;
- o data transmission possibility; and
- o speech scrambling.

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2.3 Our Experiences and Problems as a Satellite "Cellular" Communication User

In this mobile society and how has it improve the Pacific Rim Hemisphere Cultural Growth and Development.

In Satellite "Cellular" Telecommunicating usages in this mobile society our Experiences and Problems has been the emergent "needs" and immediate satisfaction of management and user benefits in times of disasters and emergencies and actual "pinpointing" of hazards and danger points. It is also our common saying, BONUM COMMUNE, "for the greater good of mankind. Thus, preparation for the eventuality is greater for us in planning or a "time frame" is set-up by us before any project or "program" management is undertaken by us. In the event, all the safety "factors" and technical parameters are being made not by us in advanced before it recurrs or occurs so no faulty "deductions" are blamed on us, but preciseness and occurences are accrued and benefis are assigned to us. Thus Benefits as against cost is greater on the ratios will be at 4:2 or Equity is at 4% and Debts is at 2%.

2.4 Using ISDN for Satellite "Cellular" Telecommunications Integration for the Pacific.

The continued cooperation among ISDN users is necessary for satellite "cellular" Telecommunication Integration for the Pacific and to ensure the successful deployment and cost-saving use of ISDN applications and Technology. If we could considerably revolutionarize the ISDN for the successful telecommunications Integration for the Pacific then this would be a paradigm on change for the satellite "cellular"

Telecommunicality as in combination with ISDN. It is indeed very timely for us to assure the many benefits that the general public at large will gross for the ISDN challenges we are mainly targeting its goals for the Telecommunications Integrations for the Pacific Rim Regions.

ISDN Technology has indeed three general elemental bases:

- o switching nodes
- o networking interconnection
- o customer terminals

By those three basic ISDN elements is directly and objectively impacted by negotiation of standards and the availability of equipment. The many interconnecting standards such as the islands via signalling system 7 (SS7) or other switched digital service has become an objective cooperation and integration of Telecommunications for the Pacific Rim Regions during the past year has created and successfully demonstrated ISDN applications such as dial-up video and low cost Group IV facsimile, Nationally and internationally.

2.5 Radio Frequency (RF) uses in Digital Microwave.

2.6 The Combination of "IRIDIUM" and "Cellular" Telecommunicating, improves Mobility and access to Data.

Iridium and "cellular" Telecommunicating will certainly improve mobility and accessing to data that will be interconnected with a nearby ground-receiving station by the Nordic Mobile Telephone NMT or a Groupe Speciale Mobile (pan-European cellular) GSM.

More important basic telephone services, by "Iridium", and "cellular" telecommunications will now be possible:

- o Transferability of calls to another number;
- o queueing at a busy mobile telephone number;
- o Indicatability of calls commonly received;
- o conference calls with three parties; and
- o closed and united subscribing groups and prioritizing subscribers classes.

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This are possible for add on services for "Iridium" and "cellular" telecommunications that requires external equipments.

In Microwave Radio Frequency (RF), Requesters and active bi-directional non-frequency shifting gain devices, performed signal amplification directly at radio frequency instead of at intermmediate frequency or fuseband. Radio Frequency (RF) repeaters have been used in low - to medium - capacity analoging and digital microwaving systems for extended path lenghts getting around obstructions or improving fade margins. Hundreds of the RF repeaters are installed around the world, from snow-covered ALASKA to the deserts of Oman, from the tropical jungles in South East to the rough aides mountains in South America.

Alternatives are now being considered for a final non-dropping "through" repeate in the microwave relay system are back-to-back antennas, single or double passive reflections, a regenerative repeater with two terminals back to back or an RF repeater among these choices, the RF repeater is usually the most cost effective solution for a wide range of path scenarios; it can only be installed at only 20% to 50% of the cost in a rege nerative repeater are to its low infra structure and minimal ongoing operation and maintenance costs. The RF repeater can also provide four superior performances than the passive methods.

2.6 ILLUSTRATIONS/PHOTOGRAPHS/FIGURES:

2.7 FOOTNOTES/REFERENCES

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Telecommunications 2000 in Korea: Videotex Trial and Policy Implications for the Promotion of Informationalization of Society

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ABSTRACT

Despite government's push for the promotion of videotex in Korea, this study found that government now needs to seriously consider the shift in its focus of public policy from an unidirectional government push to a more consumer-centered marketplace approach from an evolutionary perspective. Videotex services are analyzed from comparative and historical perspectives with focus on media adoption and use. Three key areas of public policy for promoting videotex as service oriented media technology are provided.

1. Introduction

Korea Telecom (KT) plans to distribute 10,000 videotex terminals to potential subscribers in a grant-type leasing term during 1991 for demonstration of services. The demonstration videotex services will offer 40 kinds of information including telephone numbers, taxation, medicare, economic-scientific-technological data, real estate transactions, traffic situations and amusement games [1]. More than 35,000 additional videotex terminals will be distributed to potential subscribers by the end of 1991. No charge will be imposed on the use of 10,000 demonstration videotex terminals for the one year period beginning in July 1991, while only meager charges will be levied on the use of 35,000 other videotex terminals to be leased later. KT also plans to promote the increase use of PCs, from the current 1.5 million sets to 10 million in the near future. It will also increase its *Hitel*, Korean version of *Minitel*, services to reach 3 million terminals [2].

This project is based on the Revised Three Step Diffusion Plan of Data Communication in 1988: from 1988 to 1991 would be "evaluation and development of technology and supply of 100,000 videotex terminals"; from 1992 to 1996 would be "commercialization of services"; and from 1997 to 2007 will be "connection to ISDN and establishment of terminal market"[3]. Another study by the Research Institute of Social Sciences (RISS) at the Seoul National University projected a 10% of videotex diffusion during the first stage (1988-95), 30% during the second stage (1996-2000), and 90% during the mature stage (2001-2010) [4]. Considering the RISS report's as well as other studies' much too optimistic projections (see Table 1), the KISDI report argued that increase of videotex service based on the natural growth of market size would not be appropriate. Thus, the same report suggested that the videotex projection must be made based on the KT's terminal distribution plan.

However, even the free distribution of videotex terminals does not necessarily guarantee a successful adoption of the service by consumers. Instead, the history of media adoption and videotex experiences in most pioneering countries have shown that electronic communication is less the evolution of technical efficiencies in communication or market drive, than it is a series of arenas for negotiating issues crucial to the conduct of social life [5].

It was only a decade ago when videotex was a central topic on the policy agenda of telecommunications in many countries. Most videotex projections were optimistic until the mid 1980s [6]. The notion of technological determinism has been popularly used by government and industry to generate acceptance of innovative products.

But the initial enthusiasm seems to disappear today after a number of national trial and errors. While European videotex systems have been frequently touted as successes [7], they are not the glowing success that many would like to believe. Only *Teletel* in France has often been quoted as an exception in terms of subscriber numbers [8]. When it comes to accounting its social impact, however, even the *Teletel* system is considered as 'still very limited' [9]. In the US, videotex has shown very slow but steady upwards trends in subscription based on the free market philosophy that has allowed other mass media to prosper.

In the context above, what will be the most important role of the public sector in promoting informationalization of society? Our recommendation for Korean public policy is to take an evolutionary approach with a unique regulatory scheme which is based on cooperation. In order to provide evidence for this recommendation, we will first overview videotex services and some selected studies on videotex

developement in Korea. Second, we will explain why Korea must take an evolutionary approach. And finally, three recommendations for public policy will be provided in order for the government to promote the informationalization of Korean society.

2. Videotex[2] in Korea

2.1 Overview of Videotex Services in Korea

The number of subscribers to on-line electronic information services in Korea is expected to reach 200,000 by the end of 1991 [10]. *KETEL*, the largest information distributor of its kind in Korea, now leads other vendors with 110,000 users, followed by DACOM with 22,000. Competitors, however, were insisting on a commercial base business, each with a mere 50-500 users. The number of information providers (IPs) increased from 72 in 1987 to 154 in October 1990.

While private information distributors have to rent telephone lines for non-voice service at a monthly cost of approximately $150 -$1,000 per line, *KETEL* has been offering its products free of charge from the beginning of its business in 1985. According to a report by the Computer & Communications Promotion of Korea, only 2,000 computer users out of some 150,000 password holders can connect to the computer services simultaneously.

In accordance with the popularity of electronic information services during the last few years, the number of PCs reached 1.5 million sets at the end of 1990. This represents an increase from 1.8 sets per 100 people in 1989 to 3.6 sets in 1990. At the same time, the number of computer journals also jumped up to more than 20 kinds during the last three years [11]. The production of modems also increased to 80,000 units in 1990 from 35,000 in 1989.

The subscribers' connection time to *KETEL* for the first nine months of 1990 reached about 3 million in aggregation [12]. Information searching time by *KETEL* users during the same period averaged 765 seconds. An user survey by KISDI in 1989 revealed that the average membership fee was about $70; that average access time to the service was 3.2 times per month; and that the average cost for each access was approximately $8.00. Access to economic/ business information comprised 56.4%, followed by general information (17.3%) and cultural information (10.9%). *KETEL-BBS* (Bulletin Board System) has been offered since August 1991 without surcharge by the *Korea Economic Daily*, parent company which also provides *KETEL English* databases.

DACOM has been providing *Chollian I* videotex service since 1986 temporarily and *Chollian II* since 1988. Some 9,900 subscribers of DACOM's *Chollian II* used computer aided health diagnosis service 27,831 times in June 1991, which means that *Chollian II* subscribers' average access time to the health service was 3 times per month [13]. *Chollian II* subscribers can also select their own subjects based on school curriculum via PCs. The contents of this educational service are changed and updated every two weeks. They can compare their educational level with others in the same district or nationwide by taking regularly scheduled exams with surcharge of $14.00 per month.

According to a 1991 survey research among 768 subscribers of *Chollian II*, 84% of the respondents replied that the service was helpful to their school performance, of which 77% reported improvement in one area of subjects, 44% in two areas. The most popular subjects were English (34%), followed by mathematics (32%), and Korean language and literature (28%). Over half of the respondents (54%) accessed to the service 2-3 times a week, 23% 4-5 times a week, 58% spent about an hour as average per access [14].
KT has experimented a *Chollian*-like service in Seoul area and plans to expand its service nationwide for free until 1992 and then to charge approximately $15.00 per month for the service. KT's *Hitel*, originally designed to mimic *Minitel*, is being aggressively pushed to reach 3 million terminals. In April 1990, Dong-Ah Computer of Korea signed an exclusive *Minitel* supply contract with Intel Matique, an affiliate of the French Telecom, and the Korean firm has conducted a test run of *Minitel* in 1991 to put in commercial operation [15]. About 40 Korean users, such as private enterprises and individuals, were utilizing Dong-Ah's *Minitel* test-run service. When the service is put into commercial operation, Dong-Ah plans to charge some $1 - $2.50 per minute for its service.

Currently, electronic mail services are provided by KETEL, DACOM's PC-Serve, Koreanet's Infor-Serve, and PosData's Pos-Serve. PC communication users pay approximately $14.00 for membership fee for the PC-Serve and 2-3 cents per minute for the access. While KETEL does not charge for the membership or access to the electronic mail service, 70 cents per minute is charged for the English version of KETEL and 45 cents for the trade information service. PosServe has no membership fee but charges 3 cents per minutes for the basic service with surcharge of information service.

In addition, Korean Broadcasting System (KBS) started its regular teletext service in August 1990 after 24 months experimental broadcasting. The Munwha Broadcasting Company (MBC) started a similar service in 1991. Three local TV manufacturers introduced five different TV models with built-in decoders with the price range of between $700 and $1,000.

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2.2 Videotex Forecasting and Research

In November 1991, as was in 1990, KISDI urged the government to continue to invest in the information and telecommunication industry in an effort to foster the industry as a strategic industry. The institute projected that the information and telecommunication related manufacturing industry in 2000 is expected to grow 100 percent from 1985, while telephone services are likely to emerge as a high-value added industry. At the same time, the Government intended to get a five percent share of the world information industry market by 2000.[3]

In accordance with the measures, the government plans to establish a national main computer network by 1996, to supply 10 million units of computers, and to train 10,000 information and communication technicians, both by the year 2000 [16]. To support domestic communication and information industry, the government plans to invest a total of about $265 million during the period of 7th five-year socioeconomic development plan (1992-1996). In July 1991, it was reported to the National Science-Technology Advisory Council that the Communications Ministry plans to pour approximately $6.7 billion into research and development projects for the information and telecommunications industries through the year 2000.[4] KT spent $180 million in various R & D projects earmarked for 1991 [17].

In this context, a series of studies and trials for the acceleration of videotex diffusion in Korea have been initiated by KT, KISDI, ETRI, and DACOM since 1982. As Table 1 shows, the rosy projections by most research studies seem to have followed the rhetoric of new technology in many other pioneering countries during the late '70s and early '80s. While it is true that Korea has come a long way in a quite short period of time in telecommunications, it has been achieved in hardware sector not in software area.[5]

3 Videotex 2000 and Beyond in Korea

Considering the practices in media diffusion in general, the speculation of videotex adoption in the year 2000 in Korea needs to be conservatively reevaluated for three reasons. First, the ability of Korea to offer new services in such areas as videotex and data communications is still very weak. Second, the consumers response for the possible adoption of new media needs a more careful interpretation. Finally, there has been a cultural lag in technology diffusion. We will discuss these three areas with emphasis on a historical aspect of media diffusion and lessons from videotex experiences of some selected pioneering countries.

3.1 Weakness in Software

While VAN market in worldwide including Korea is expected to rapidly grow (Table 2), Korea's capability to provide information services is very limited (Table 3). For example, in 1988 domestic revenue for VAN services marked Won 6.4 billion ($8.7 million). In 1990 it hit Won 15.6 billion ($21.1 million). According to a recent survey by the Information Communication Promotion Association in Korea, 80 information producers provide 115 DBs during 1991 [18]. More than half of the services began to be provided after 1990. Considering that the majority of the 65 domestic databases shown in Table 4 were developed by most government branches for their own purposes, commercialization of them is far away from now on.

Currently, 44% of the services are free of charge. However, a significant number of users discontinued the service after DACOM decided to charge for the access to *Chollian* service. *KETEL* also worries that a considerable number would discontinue the service if they charge for the access. This means a weak base of videotex users. Unlike manufacturing capabilities (i.e., hardware orientation) which have led Korea as one of the leading world traders, service areas which depend on software or service are not likely to be pushed in such a short period of time. Development of software area takes longer than that of hardware whether in information or in entertainment. Professor Porter at the Harvard University also pointed out the weak base of software industry in his discussion of promoting Korea's telecom industry [19].

In contrast, the number of Korean firms using DB obtained from abroad rose 50% from 1,420 in 1989 to 2,130 in 1990 [20]. The heavy reliance of Korean firms on foreign DB services stimulated foreign DB service companies rush into Korea, especially Korea's DB market open on July 1, 1991. Some 20 foreign DB firms are now moving from their indirect to direct on-line services through their agents in Korea. Of these, BRS and EMIS of the US and SDB of Australia have already conducted market surveys in Korea to prepare for their direct services in the country [21]. During the mid 1991, Independent Publication of the US also concluded an agency contract with Samsung Trading Co. to provide its NEWS-NET services, including 500 newsletters covering some 39 countries [22](see Table 5 for more information).

At the same time, media history has shown a correlation between hardware versus software industry. Once any medium technology is introduced into a market, the space or

An international comparison of the videotex forecast is interesting. As Table 6 shows, the forecast were quite optimistic in most countries. The Germans, for example, were aiming for a potential market of 3 million subscribers by 1990 and up to 8 million by 1993. In 1990, they actually reached 250,000. The number of IPs even declined from 4000 in 1985 to 3,300 in 1989. In Britain, more than 10 million would subscribe to videotex services in 1989. A 1990 figure was still 200,000 even including non-BT subscribers. The almost 6 million of *Teletel* service in France should have 30 million subscribers in 1990, if the projection was correct.[7] (See Table 6)

In the US, AT&T projected during the early 1980s that 7% of American public would subscribe to videotex services by 1990 [36]. Another study by the industry estimated that by 1995 about 20% of all households in the US will have adopted the service [37]. Most projections for the US videotex in the table 5 were similarly optimistic when they were made. According to the Videotex Industry Association estimate, however, the number of videotex users in 1988 was some 700,000, or 1.1 percent of US households [38]. The number of videotex customers is growing about 30% a year - to 1.3 million in 1989, reflecting increasing use of home and office computers [39]. A recent issue of *Business Week* (June 17, 1991:112) estimated that about 2 million Americans subscribe to on-line services, with passing the 1 million on *Prodigy*.

3.3 Technology and Cultural Lag[8]

3.3.1 Media Literacy

Patterns of media progression generally follow the EPS curve - grown from *e*litists to *p*opular to *s*pecialized [40]. The growth is slow due to initial technical difficulties when a technology is new. Once the difficulties are overcome, however, growth in performance and market acceptance is often rapid, then followed by a slow curve again. This S-shape process can also be seen from a life cycle perspective in economies, business, and products within them, like people and all other living things [41]. In the first stage of media development, only the elite are literate (i.e., media literate) and can afford to obtain messages from all media. Once the first stumbling block is broken, 'mass-mass' media dominate the second stage, in which content is designed to appeal to the great majority of the population based on the 'lowest common denominator' principle. The final stage of the EPS curve requires four conditions: widespread higher education (literacy), an affluent population, available leisure time, and significant population size (See Figure 1).

Videotex adoption is more likely to be the specialized stage of the model above from the beginning. Particularly, if the concept of literacy is broadened to include other media than printed text, it would seem that there will be a continuously increasing sophistication of multimedia literacy even among the haves and the learned. While videotex is likely to follow the overall developmental *S* pattern in its process of adoption, a refinement of the diffusion theory was suggested with minor modifications.[9]

3.3.2 The Chicken-and-Egg Problem

All of the new communication systems including videotex have at least a certain degree of interactivity. As an extreme example, the first adopter of telephone which is an interactive technology has zero utility until a second individual adopts. This critical mass dimension of the interactive communication technologies is a crucial factor in their adoption and use. In addition, the control of mass communication systems usually moves from the message producer to media consumer by providing an exchange capability of special message with each individual in a large different information from an interactive communication systems. This implies that IPs provide a variety of services in order to satisfy the fragmented consumers.

However, it is hard to determine the needs and wants of videotex services in the future because demand formation is an interactive process where user preferences are interdependent and collective learning is involved [42]. In other words, videotex development is on the one hand an interdependent process where the 'user value' of the system depends on the size of the user community. On the other hand, it is a collective learning process where late adopters learn from early adopters because users have to get acquainted with the system, discover or even invent new applications [43].

This interactive process can lead to the famous chicken-and-egg problem, which is often located in the start-up phase of the system. Subscribers of videotex will buy terminals only when there is already a certain critical mass which make the communication network interesting and useful. Terminals will only sell large quantities only if there are large economies of scale. The information providers will also spend major money only if they expect that there is a sufficient size of user community.

In addition to the actual use of videotex service, adoption of videotex terminals is also contributed to the chicken-and-egg problem. Assumptions about the type of videotex terminals were different from country to country. Initial thought in Britain was that the TV set with a special decoder would be the typical display device. Despite the more technical options

time of the medium must be filled up with different form of information. For example, the recording industry was the prerequisite for the development of FM radio, as movie industry was for TV, which have helped further the cultural dependency of developing nations on more industrialized countries. Video cassette recorders took off when variety of programs for playing (rather than recording from TV) became available during the mid 80s.

Japan, despite its economic super power, is still struggling to develop software industries whether it is in the entertainment sector or information sector. Recent buy-outs of US recording companies and movie studios by Sony and Matsushita are good examples in entertainment area [23]. In the information sector, Japanese revenue from the database business accounts for one fifth of the US, the number of IPs one tenth, and number of producers one twentieth [24]. In addition, both language and economies of scale would further delay the promotion of information service in non-major language speaking countries no matter how superior in hardware technology.[6]

3.2 Market Research for Videotex

Survey researches in Korea have demonstrated that ethos of videtex has not been established among the general public [25] or even among journalists [26]. According to a survey research among 506 telephone users in Seoul area during the period of June 1988, 38% of them responded that they would be willing to use electronic directory service (EDS) even if they have to buy a computer, 15% would be willing to pay a telephone fee for the new service *if* computers are installed free of change; 34% would like to wait and see, and 8% would not be willing to change from the print directory to electronic directory anyway [27].

While this response was positively interpreted in the report, further analysis implies that general consumers are not yet ready to adopt this new technology. For example, while those who have some experience with computing comprised 54% of the positive group (i.e., willing to subscribe anyway), those who have no experience of computing accounted for 35% of the same group. It is a significant difference between the experienced respondents and the non-experienced ($p>.05$). Major reasons for the 'hesitate' were "don't feel the importance of information" (35%), followed by "too high extra expense" (27%) and "uncomfortable with computing" (24%). When it comes to considering the limited numbers of the general public who know how to operate even typewriter, and the sample was collected from Seoul area which is the center for every sector in Korea, this finding needs to be more conservetively interpreted.

A 1990 survey among 200 professionals in various areas also found that public relations in "creating information mind and culture among the general public" was the most significant project among the various policy agenda for promoting informationalization of Korean society [28]. In another KISDI study of 1989, respondents showed their primary interests in unique/special news which is unavailable from other media. Then, videotex consumers want to have constantly up-dated data which can help their economic and business interest which is more towards business rather than general consumers [29]. Despite the positively interpreted responses by different studies, the demand for videotex service until August 1988 was so limited that KT announced its plan to pour Won 1,200 billion by the year 2007 for promoting the service [30].

These studies should not be regarded as exceptions when it comes to considering the previous studies in pioneering countries. Evaluation of videotex *Gateway/Viewtron* indicated that the test families used videotex as much or more than conventional media forms, and more than half of the homes accessed and used the service for more than 30 minutes each day [31]. According to the "*Viewtron Newsletter*," 68% of 200 households involved in the original test of *Viewtron* purchased at least one item through the system. On the other hand, fewer than 1,000 items were purchased in the 14-month trial. This ostensible need of individual did not necessarily drive their choice of medium.

Further, innovators and early adopters may reveal uses not expected or apparent to researchers. The open character is particularly apparent in the case of the basic communication technologies, the telephone, the computer and the electronic messaging network, which offer a means of control or communication, while leaving the end for the user to define.

For example, sociability as a major use of telephone had not been a taken-for-granted fact when early advertisers suggested this technology as an extension of telegraph which had been mainly used for business and household management. The telephone as a means for 'trivia gossip' was not envisioned by the industry but was invented by the users [32]. Similarly, the *messageries* in *Teletel* had not initially been foreseen, but was invented by the users [33].

This noble application was outside the bounds of the producers' and researchers' expectations for use of this new service. In other words, videotex has been caught between its conception as a vehicle for public information, its role as a medium for commercial transaction and its adoption as a public message board [34]. This process is referred as 're-invention in diffusion theory' which means "the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation" [35].

of other countries which launched later, two compelling ideas had led to the overly sophisticated and complex display standard (i.e., a more sophisticated display standard and a more decentralized system would make the services more acceptable for private households). In Germany, these ideas resulted in many additional 'technical snags' in the terminal business and the system architecture [44]. In Canada, *Telidon* technology was a 'cornerstone' for the standards defined in North America with high quality graphics with 240 x 320 picture elements (compared with 60 x 80 for the British traditional videotex). In Japan, *CAPTAIN* (Characteristics And Pattern Telephone Accessed Information Network) was specially designed to solve the problem of 3,500 Japanese characters as well as roughly 120 Latin symbols and alphanumeric characters. Result: all the sophisticated terminals have shown very limited acceptance by the consumers in each country.

In contrast, French telephone subscribers were to receive a simple and integrated compact terminal (i.e., *Minitel*) free of charge from their PTT as a substitute for the telephone book. The *Minitel* could also be used for other information services and whose diffusion was under the PTT's control [45]. The French did not concentrate on graphics display as we see in Canada, Germany, Japan and the US but had other advantages - a full range of tested software and hardware that was easily taken to market. While the free distribution of terminals has been related to the 'French success,' high diffusion rate of terminals does not necessarily mean 'frequent use.'

In the US, there is no government mechanism for developing a nationally coordinated videotex system. But the US industry also believed that graphics were more important as an integral part of the technology and therefore would be more important to the consumer. AT&T's NAPLPS (North American Presentation Level Protocol System) was formally approved by the American National Standards Institute in 1983. However, potential users in the US bought PCs (ASCII) instead of dedicated videotex terminals. *Gateway* and *Viewtron* encountered tremendous marketing resistance to the AT&T's *Septer* terminal costing $900 [46]. By the mid-1980s, attention shifted to creation of software that let subscribers transform their PCs into videotex terminals. PCs are less sophisticated in graphics but faster than NAPLPS with more functions. Thus, PCs and software are being designed for better color and graphics as a result of the evolution of videotex into use almost exclusively with PCs [47]. Among the over 20 million PCs users in US homes, there is a market of 1.7 million videotex subscribers with perhaps 450,000 'hardcore' users," if we adopt Arlen's '25% pyramid.' According to Arlen, "25% of US homes have computers, 25% of those have modems, 25% of modem owners subscribe to online services, and 25% of subscribers are frequent users [48].

3.3.3 Entertainment Value over Information Value

The real determinant of what sort of videotex service makes sense is the information it provides in relation to the needs of the consumer. While videotex has much higher information to entertainment ratio than most media, information is not a high priority for the consumer [49]. It seems common among the general public that entertainment is more valuable than information or education crossculturally as well as historically.

Videotex is perceived as a consumer-oriented product because of the relative popularity of the *Teletel*. However, consumers use *Minitel* as a "screen based telephone, to communicate with other people, not to retrieve information" [50]. More specifically, the *'messagerie'* service accounts for 8% of calls, 22% of revenues of total *Minitel* time. In contrast, electronic directory service is providing 18% of revenue from 33% of calls [51]. In addition, *Funitel* was rapidly climbing up to $7 million a year. Callers were playing blackjack, requesting psychological questionnaires to assess compatibility with a loved one, or playing transnational chess with another partner. In other words, the key to all the robust activity in the *Teletel* seemed to be a high degree of entertainment-oriented interactive services rather than static pages [52].

Consumers' 'fun-orientation' in their videotex use was already found in *Prestel* in Britain, *Captain* in Japan, and *Gateway* trials in the US. The *Captain* system, for example, showed that amusements and hobbies were accessed 52% of the time, following at considerable distance were education and culture (14%) and sports (9%). *Teletel* 3V revealed that news and entertainment information was the undisputed leader in accesses. Bringing up the rear was education. In *Gateway* trial in the US, asked to identify essential components of a future services, 79% of a select group of likely subscribers listed games as the most essential [53]. The Computer Memory Project at Berkeley, California found uncensored sex jokes at the rate about fifty a day [54]. A large volume of jokes were also carried on ARPANET, a bulletin board for defense research contractors provided by the US Department of Defense.

In short, the users of computer bulletin boards, just like everyone else, like to have fun. Then, 900 sex-phone service can be extended to videotex services naturally as a good business. Now, Prodigy does not post messages that it considers obscene or irrelevant, while *CompuServe* and *GEnie* let members freely create much of it. Of CompuServe's many chat channels, the ones labeled Adult and Alternative Lifestyles are the busiest [55].

Finally, media history also shows consumers' preference of entertainment over information. As Table 7 shows, it took about 5 to 10 years for the popular entertainment media such as radio, TV and VCRs to reach 30% of the public, compared to 20 to 30 years of the information media such as telephone and computers. It takes about 40 years for television to reach 98% of the households, while it takes for 100 years for telephone to reach 93%, even though it has been subsidized by the government. The television industry itself suffered in the early days from lack of programming and crude presentation but it lived to become the highest consumption medium ever with the quality of convenient, cheap, and 'novel entertainment.' "Knowledge was ornament rather than necessity" [56]. And this is unlikely to change in the short term.

The preference of entertainment value over information leads to another concern – business versus residential use of videotex. The recent revival of videotex interest can be attributed to more business applications. The videotex would be dominated by business users because of information delivered to businesses rather than homes, and because there is little evidence to show that homes want or can afford videotex.[19] Business customers are willing to pay for goods and services that save time and money. Thus, videotex was seen as a means of corporate communication with employees and customers that could create or enhance a competitive advantage [57]. Personal users also value time and money but in addition seek entertainment, physical security, and alternative ways spend large blocks of leisure time. It is the difference between a specialty market and a

mass market which are kept apart by lack of compatibility. The failure of residential users to embrace the instrumental aspects of *Prestel* as well as *Captain* led to the shift in its marketing toward business users.

The early history of telephone usage is largely the story of how commercial and professional communities adopted the new means of communication. The telephone tended to be the monopoly of American businessmen in its first decade not only because they often simply substituted it for a telegraph but also they could afford AT&T's high rates better than most other Americans [58]. The telephone was a boon not only in the organization of industrial and manufacturing activities but also in the vacation industry and hotel industry. By 1900, for example, practically every large and medium-sized hotel and many small hotels had telephones in every guest room. The trend toward a telephone in every American home started when the rapid roads of the telephone into the industry reduced the cost of service substantially. Social use of telephone began to be accepted by the public almost 20 years after Bell gave a lecture in 1877 that his invention would enable people to socialize at a distance.

3.3.4 Media Quality and Functional Alternative

Furthermore, audience choices themselves are linked to *media characteristics*. Each mass medium has particular qualities or attributes that lend themselves to particular types of appeal [59]. Print media are strictly visual. Thus, magazines and newspapers are designed to catch the eye, through color, pictures, headlines, drawings, and even the size. Messages transmitted by radio involve sound alone, while TV and movies are appeal to both sight and sound.

In their process of adoption or use, people not only compare cost but also account such functional advantages as convenience, portability, time flexibility, indexability, method and speed of distribution, content, permanence, interactivity, and personailizability etc. Videotex has emerged not as pre-given wholes but rather as sites of contest for different uses, interests and visions. In fact, mass media do not appear overnight, of their own volition, for no good reason. With the appearance of each new medium, existing media have had to adapt during period of uncertainty based on such medium qualities. Videotex is just a new comer (see Table 8).

Consumer information gathering is less often purposive information seeking than recreational browsing, which affects the choice of medium [60]. In this sense, it is difficult for videotex subscribers to know what they are choosing from - the 'big picture' of the day's news, i.e. it is non-indexable. Further, videotex requires some degree of interaction to control or at least access to media – typing or pushing buttons. Thus, retrieval remained cumbersome compared to competitive print media – newspapers and magazines. In addition, electronic text is much less portable than its printed counterparts. Despite being comfortable with the PC medium, loyalties remain for traditional print media [61], especially in the enjoyment and social connection areas [62]. Media habit played a role inspiring these loyalties [63].

Now the newspaper industry understands that videotex service is not an electronic newspaper but a computer-based new electronic product in the US.[11] However, they thought videotex would pose a competitive threat and, therfore, entered the market as a defense. Videotex technology forced on the consumer does not justify his paying of 100 times the cost (on a per-word basis) of the conventional, universally acceptable newspaper [64]. Sears did not see tele-shopping replacing catalogs in the *Trintex* trial, saying the mass audience was still dubious about electronic technology and would not have it forced on them [65]. French consumers often preferred using paper directories: while over 60% of *Teletel* users requested paper directories, 92% quote the directory service spontaneously when asked what services they use [66].

In the sense above, videotex industry must have incorporated consumer needs and uses into the existing format as the *Teletel* emphasized videotex as an extension of existing services rather than as a new fancy service in its introduction. In fact, videotex services emerged as little more than an alternative delivery mode for a few of the traditional products of banks, retailers, and the media [67]. For example, a content analysis of *Viewtron*, *Gateway*, and *Keyfax* found that a majority of stories came from the wire services and most of the rest from the local paper owned by the system's parent company [68]. In short, electronic news rose above "rip-and-read radio for the eyes."

Further, it would be necessary to account voice processing, facsimile service, and shopping services on cable as the functionally competitive new media in the future. Both content and format of audio communications need to be brought into considerations of the future of videotex [69]. In fact, we are still in a predominantly voice world today. Despite the high-speed digital technology in the network, anything from 6 to 12 times as much voice is processed today compared with other services [70]. While researchers have not spent much time on format aspects of audio communication, voice processing is spreading.[12]

Audietex is an easy and fast way of find information. By dialing hundreds of numbers, a caller can receive a customized information from a computer 'voice' instead of watching it on a television or computer screen. Voice processing may be a competitor of videotex, especially when ordinary PCs turn into voice systems. Pacific Telesis planned to introduce its own gateway in San Francisco in 1990 by concentrating on audiotex services, not on videotex, despite a bountiful, home lease of high-tech companies in the area [71].

Beginning January 1990, the *New York Times* began publishing *TimesFax* targeted to Asia. By 1991, the *Los Angeles Times* plans to launch *NewsFax*, a four-to-eight page faxed newsletter targeted to Moscow [72]. In Japan, facsimile broadcasting offers information promptly and permanently in the form of hard copy. Speed and permanence have never been simultaneously offered by any traditional media. It is widely believed to be the third most important media after newspapers and TV broadcasting [73].

The cable home shopping was not the accepted approach to advertising when the Home Shopping Network (HSN) began in 1985 [74]. The apparent success of television shopping programs was believed to be a threat to turn cable and independent broadcasting into a 'giant flea market.' In 1989, HSN with 60 million subscribers and QVC/CVN with 37 million marked over $2 billion revenues [75]. According to Kathy Jurado, HSN's vice president for corporate communications, "We serve a dual purpose – shopping with entertainment value – while videotex services are more of an information service, a 'still life' service."

4 Policy Recommendations

4.1 Unique Public Policy with Vision for the Long Term

There are three strategic areas for improving competitiveness in telecommunications in Korea: establishment of integrated networks; providing a broader range of telecommunications

services; and be a truely global competitor in both hardware technology and services in the international market (These are professor Porter's reccomendations). In order to achive these goals, it is now important for Korea not only to just copy what other nations have done but to create its own unique regulatory climate and its own unique network based on a unique cultural tradition. A pure decisional approach would be rather meaningless without taking into account the special conditions in the different countries which changed overtime. The history of media adoption and videotex experiences in most pioneering countries have shown that electronic communication is more than the evolution of technical efficiencies in communication. It has been a series of arenas for negotiating issues crucial to the conduct of social life in a unique cultural tradition, which must be seen from an evolutionary perspective.

4.2 Regulation as Coordination: Conduit versus Content

Korea could be one of the first countries to achieve an ideal ISDN because she already makes distinction between conduit and content, and still retains government ownership of the nation's largest communication facilities. However, the separation of government function does not necessarily guarantee any successful videotex adventure. The common carrier policy in many countries did not work as planned in the development of videotex services.

A key factor for success in videotex is development of a central co-ordination mechanism. The different components of videotex system (services, network, and terminals) are developed in a coherent and balanced way so as to solve the different economic dilemmas and the technical problems inherent to large technical 'network systems.' This central co-ordination function may be performed either by public agency or private corporation hierarchy. Considering the state's politically accountable authority and greater legal and institutional capabilities to organize the cooperation between various partners, a government agency may well be best-placed to perform this co-ordination function. Again, the capability of orchestrating multi-faceted interest groups as well as the separate but intertwined government branches is essential.

4.3 Step-by-Step Approach

More specifically, the master plan must be provided based upon thorough understanding of the mistakes made by other countries and the relationship between media quality and consumers' media habit.

As the information economy is creating 'scores of niches within niches,' videotex is envisioned as a primary source of micromarkets in the long run. If the information infrastructure is completed and virtually everyone will be connected to a public electronic malls, may be between now and 2010, thousands of specialty markets may appear. However, public policy must take an evolutionary approach because specialized information will be in the domain of business rather than the residential, at least for years to come or even longer than a decade.

Therefore, promotion of computer use in business sector and higher educational institutions, computer and terminal use among government branches as well as lower and middle educational institutions must be the first step of diffusion strategy. Future users, first of all, must be media literate which required several hundred years in the print media. Compatibility between terminals and computers will be the prerequisite. At the same time, the general public needs to be educated about the technology as an extension of human being's physical limitation, and media as another extension of our sensory systems, both are natural to human's instinct. IPs also needs to be encouraged to start in business and science sectors first. The market for the general public's residential use needs to be developed based upon the experience and relatively acceptable profit from these areas.

NOTES

1 Rice & Paisley counted 50 projects in 16 countries [Rice, D. and W. Paisley (1982) "The Green Thumb videotex experiment evaluation and policy implications," *Telecommunications Policy*, 6/3:225]; Gillies reported 115 videotex in 1983 [Gillies, D. (1990) "Technological determinism in Canadian telecommunications: Telidon technology, industry and government," *Canadian Journal of Communication*, 15/2:6]; and Alber provided 22 countries. [Alber, A. (1983) *Vieotex/Teletext*, New York: McGraw-Hill, Inc.] During the late 1970s and the early 1980s many countries had similar goals and motivations for getting involved in interactive videotex. It has been recognized that telecommunications industry is one of the most crucial areas that really creates the infrastructure for economy: It provides an infrastructure for many companies; it influences a country's research activities; and it promotes software network equipment and information services. Therefore, most countries were looking for (1) an opportunity to increase PTT's revenues by providing new services which will increase the traffic in their existing telecommunications networks; (2) the new products for the time when the telephone would reach in its saturation point; and (3) the support of domestic industries in telecommunications and consumer electronics. Thus, the objective in all the countries was to reach the mass market effectively and efficiently. While this push was initiated by the governments in the European model (included Japan and Canada), it was provided by the banks, retailers, and newspaper industries in the US mainly as a defensive venture.

2 No single set of definitions of videotex has been commonly accepted in the field. Videotex, for example, is variously used to refer to a television-based broadcast information service or alternatively for any service utilizing a computer display to display retrieved text. The lack of an agreed structure and terminology makes the development of meaningful statistics difficult and also muddies the integration of different viewpoints. Videotex is defined as an interactive information service that allows individuals to request frames of information from a central computer via telephone or cable, for viewing on a video display screen usually a television home receiver [Gross, L. (1990) *New Television Technologies*, Dubuque, IA: Wm C. Brown]. However, videotex and online databases were interchanging attributes by mid 1980s in the US. Thus, the term videotex has become a generic term for systems that has interactive capabilities and provides electronic text for distinctions eliminated as the technologies merge. This definition includes not only videotex but also online databases used in conjunction with the personal computer or multi-standard dedicated terminal. In short, the overall umbrella is taken as information services.

3 A seminar sponsored by KISDI in 1990 projected that the domestic information and telecommunication industry is likely to grow 10.2 percent during 1990-1995 period and 8.7 percent in the 1995-2000 period. By 2000, Korea's information and telecommunication industry is expected to account for 7.8 percent of total sales of all industries and 8.0 percent of the value added amount in GNP (See *The Korea Economic Journal*, September 11, 1990:4).

4 According to the R&D policy directives, state-run research institutes will be encouraged to conduct basic R&D projects, telecommunications firms applied technologies, private enterprises commercialization of developed items, and colleges and universities key and fundamental technologies.

5 We are using the term 'software' as a generic term for the content-oriented industry for any media.

6 Despite the technical and economic superiority, Japanese is not yet one of the four 'technical languages - English, French, German, and Russian - mainly because Japanese is a language understood by few outside of Japan.

7 However, someone provides a different data: the projections in France were rather low and even much below the actual development. See Charon, 1987. Recited from Schneider, et al., 1991

8 Time lag between the introduction of a technology by the industry or government and mass adoption of the technology by the public.

9 For example, the critical mass theory by J. Marcus (1987) ["The French videotex connection," *Issues and Science and Technology*, 4:108-112] suggested that a successful videotex service tends to grow geometrically. According to Markus, the long-run average cost per subscriber and cost per service of a successful videotex company will decline as in the publishing industry because there is little reproduction cost in videotex. However, this analogy is not valid when it comes to considering that (1) the publishing industry itself is not homogeneous (in terms of permanence, time flexibility, and supporting structure), that (2) most popular services on videotex need to update information continuously, and that (3) combination of joint-consumption theory and traditional diffusion theory can better explain the production cost of media content. T. Bolton (1983) ["Perceptuals that influence the adoption of videotex technology: results of the channel 2000 field test," *Journal of Broadcasting*, 27:141] found the impact of perception in the adoption of videotex, which became less favorable over time. This finding is accounted by Rogers (1986:121) in his explanation of the special characteristics of new media. See [54]. Further discussion is beyond the scope of this paper.

10 For example, the results of numerous videotex field trials also suggested that consumers were not ready. It was found that 66% of the San Diego residents he surveyed were uninterested in teleshopping because shopping was a social as well as an instrumental activity. Similarly, 55% of the respondents were uninterested in home banking because of no advantage or of personal contact preference. See Ledingham, J. (1984) "Are consumers ready for the information age?" *Journal of Advertising Research*, 24/4:31-37

11 James Holley, president of Gateway, stated that "We reached the point where we learned enough to know that [videotex] was not a threat to our newspapers or our cable companies or our magazines which is what drove us into this project in the first place." quoted in Goldberg, L. (1986) "L. A. videotex outlet not profitable enough," *Electronic Media*, 30:26

12 AT&T laid the groundwork in the mid-1960s, when it began touch-tone phone service. However, the industry did not take off until the 1980s, when micro processors, inexpensive memory chips, and large-capacity disk drives became readily available.

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TABLE 1 VIDEOTEX DEMAND PROJECTIONS
(unit: number of terminals)

Year	1987	1991	1996	2001
ITT	25,000	100,000	250,000	500,000
ETRI	12,000	57,000	586,000	857,000
BT	9,120	27,800	112,000	449,000
KTA	-	4,200	16,000	29,000
SNU		10% (1991-1995)	50% (1996-2000)	90% (2001-2010)

Source: KISDI, *A Study on the Outlook forVideotex Demand in Korea* (1988:19)

TABLE 2 AN OUTLOOK FOR VAN MARKET IN WORLDWIDE
(unit: billion dollars)

Area	1990	1991	1992	1993	1994	1995	2000
North America	104	124	146	167	190	214	393
Europe	40	48	57	68	79	90	183
Asia	32	41	52	63	75	89	204
Total	176	213	255	298	344	393	780

Source: ETRI

TABLE 3 REVENUES FROM DOMESTIC VAN MARKET
(unit: 000,000 Won)

Service	IP	1988	1989	1990
General Data Exchange Service	DACOM	6,213	7,479	11,070
	KOTIS	101	920	1,374
	Sub Total	6,314	8,399	12,444
Trade Information Exchange Service	DACOM	-	74	130
	Others	-	170	1,625
	Sub Total	-	244	1,755
E- Mail Service	DACOM	77	243	420
	Others	-	163	837
	Sub Total	77	406	1,257
CRS Service	DACOM	41	93	180
TOTAL		6,432	9,142	15,636

Source: *Computer*, 1991 August, p. 162

TABLE 4 A COMPARISON OF DBs IN KOREA, JAPAN, & US
(End of 1989)

	Korea	Japan	the US
Total number of DBs	116	2,858	4,042
Domestic	65	620	1,346
Foreign	51	2,238	2,696
Revenue ($billion)	0.4	9.6	46.7
DB producer	40	90	1,600
DB service provider	15	200	2,200

Source: *Weekly Technology Trend* by ETRI, June 17, 1991: 166

TABLE 5 INFORMATION SERVICES PROVIDED BY FOREIGN VENDORS IN KOREA

FOREIGN VENDOR	NAME of SERVICE	LOCAL DISTRIBUTOR	CLASS	YEAR of START
Dialog	DIALOG	DACOM	general DB	1983
Mid Data Central	LEXIS/NEXIS	"	"	1990
CompuServe	CompuServe	PosData	"	1990
ComLine	COMNET	Samsung	"	1991
Intelmatique	Teletel	Tong-Ah	"	1991
VITEL	VITEL	IRC	E-mail	1982
GE	QUICKCOM	DMI	"	1985
COMTEXT	LYDIASTER	Illyang Exp.	"	1988
US Sprint	Sprint Mail	K. Computer	"	1989
AT&T	EASYLINK	ST Inter'nal	"	1990
IP-SHARP	IP-SHARP	Taewoo	Finance DB	1982
Reuter	R'ter Monitor	YH Tongshin	"	1983
TELERATE	TELERATE	YH Tongshin	"	1984
TELERATE	Dow Jones	Chungang-Illbo	"	1989
Knight Ridder	Knight Ridder	K. E. Daily	"	-
BLOOMBERG	BLOOMBERG	ComTec Sys.	"	1991
JICST	JOIS	DACOM	science/medi	1984
CSC	NOTICE	DACOM	VAN	1984
NIFTYSERVE	NIFTYSERVE	PosData	VAN	1990
Maxwell Online	ORBIT	Samsung	Patent DB	1988
	BRS	Samsung	chemistry DB	1989
EMIS	EMIS	Taewoo	chemistry DB	1983
Independent Publication	NEWSNET	Samsung	news DB	1991
WTC	WTC-NET	Trade Asso.	trading DB	1984
Reuter	TEXTLINE	K. E. Daily	economy DB	1988
Nipon E. Daily	NIKKEI	Maeil E. Daily	"	1985
OCEAN ROUTE	OC'N ROUTE	Tech Marine	Marine DB	1989
Gartner Group	Gartner Online	Gartner Korea	Infor/com DB	1990

Source: A Policy Report prepared by the Economic Development Planning Board, 1991 July.

TABLE 6 INTERNATIONAL COMPARISON OF VIDEOTEX FORECAST
(in millions and %)

Country	Projected Year	Projection [million]	Actual Use
UK	1985	8.5	1986 65,000
	1989	11.0	1990 150,000+50,000 (non BT)
			IPs stagnated at 1250
Germany	1985	1.0	
	1990	3.6/3.0	1990 250,000
	1993	8.0	IPs 4000 in 1985 but 3300 in 1989
			(IPs 3700 in 1985 in other source)
France	1984	0.4	
	1985	1.0	1990 5.5 million/8,000 IPs
	1990	22-30.0	1991 6 million
	1995	10.0*	* revised projection in 1987
US	1985	5.1	1990 1.2% of the population
	1990	7.0**	AT&T ** (percentage)
	1990	30.0	Booz-Allen
	1990	52.0	Yankee group
	1990	11.0	Institute for the Future
	1990	7.0	Link Resources
	1990	12.0	Strategic, Inc.
			1991 2 million (*Business Week*)
	1995	20.0	Industry expert cited in Rogers, 1986:50
	2000	38.3	

Sources: Combined by the authors from various sources

TABLE 7 TECHNOLOGY DIFFUSION IN THE US: ENTERTAINMENT vs. INFORMATION

	Year household penetration begin	Year 30% penetration reached	Number of years to reach 30%
Radio	1923	1925-30	Approximately 5-8 (40% in 1930)
Black & White TV	1946•	1950-55	Approximately 5-7 (9% in 1950)
Color TV	1954•	1964	12 - 15
Cable TV	1952	1982	30
Pay cable	1975	1992•	17
VCR	1975	1985	10
Telephone	1876	1920	40•(35%)
Computers (PCs)	1977	1995•	20 (23-31% in 1991)

Sources: Compiled by the authors from various sources

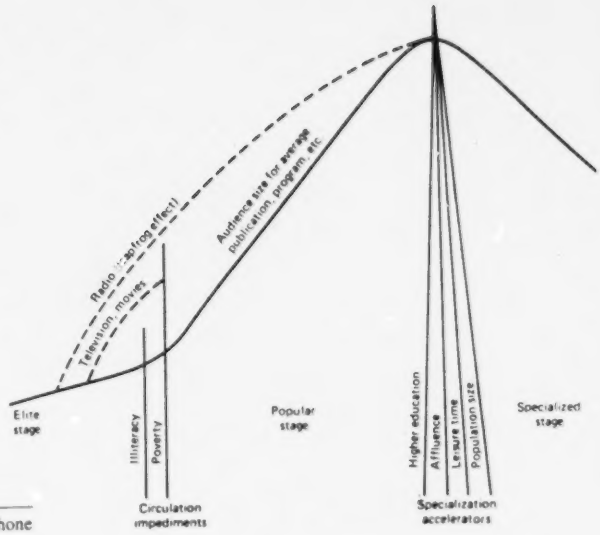

FIGURE 1
ELITE-POPULAR-SPECIALIZED CURVE OF MEDIA PROGRESSION (Lowenstein and Merrill, 1990:32)

TABLE 8 EVALUATION OF MEDIA CHANNELS

Medium		Books	Magn	Newsps	Radio	TV	Vitex	phone
sending/verbal symbols		5	4	4	5	4	3	5
receiving	picture symbols	5	5	4	0	5	3	0
	color	5	5	4	0	4	3	0
	sound	0	0	0	5	4	0	5
	motion	0	0	0	0	5	0	0
Transmission/	portability	5	5	5	5	3	0	4
distribution	reviewability	5	5	5	1	1	4	4
	simultaneity	0	1	3	4	5	4	5
	easy to distribute	1	1	1	5	4	3	4
Content	selectivity [1]	4	4	4	3	2	4	5
	versatility [2]	5	5	5	5	4	5	5
	up-to-date	2	3	4	5	4	4	5
	permanence	5	5	4	0	0	4	0
	indexability	5	5	5	1	0	1	?
	com'cial interruption	5	4	4	0	0	4	?
Feedback [3]		1	2	2	4	1	3	5
Support [4]	hardware	5	5	5	2	1	0	2
	software	3	5	5	4	4	3	3

Scale
0 very poor
1 poor
2 fair
3 good
4 very good
5 excellent

1 The ease with which a searcher can retrieve specific information.

2 The varieties of information that can be offered.

3 reviews by critics or suggestions by distributers for books; letters of calls to the editors for magazines (Magn) and newspapers (Newps); phone calls & 'talk radio' for radio; reviews by critics for TV

4 If a device or equipment is necessary for receiving the service, the rating is decided based on the price of the device; if not necessary, subscription cost and the ratio of advertising to non-advertising content on/in the medium need to be considered. Magazines and newspapers are rated excellent (5) because ads can be skipped by the readers (if they want), while radio and TV are rated 'very good' (4) but not excellent because listeners or viewers cannot skip them (even they want to).

Sources: Reconstructed by the authors based on various sources

Three Men in a Tub

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ABSTRACT

The Telco, Cable TV and Electric Utility Industries have only themselves to blame if the affections of their loyal customers are pre-empted by whichever one of them is the first to reach the home with an all-purpose all service optical fibre. An overview is presented noting the conflicts, cooperation and confusion attendant upon creating a new infrastructure based on optical technology.

Arthur C. Clarke, a familiar figure around the Pacific Basin, is wont to castigate the current generation of technocrats for what he calls "failure of the imagination". The phrase seems appropriate when applied to the practitioners of cable television, telephony and the related services provided by the electric public utilities. Recently a U.S. regulatory commission issued a call for papers on the subject to "The Entry of Telephone Companies into Cable Television". It may have been an oversight, or a failure of their own imagination, that they avoided mention of the entry of cable television companies into the telephone business. Or of the entry of electric utilities into Both the cable and telephone businesses. Or of the intrusion of all of these three interests into each others' businesses via optical fibre in whatever configuration the law either permits or can be persuaded to permit, and however it may be integrated into the infrastructure of any given country.

It is a paradox that the advanced technological situation of the United States may present the biggest obstacle to the ultimate rationalization of its own telecommunications and information systems. In the U.S. the three protagonists mentioned above will soon approach parity in their physical and economic assets. They lobby the legislatures with great diligence, seeking advantage beyond the equal rights they are supposed to have in the developing technologies of fibre optics, direct broadcast satellites, personal communications systems and interactive broadband services. But as usual, the regulatory perceptions lag behind the laboratories and nobody seem to know what the customers really want out of all this. Until quite recently the British approach was that the bureaucracy will decide what is in the customers' best interest, but now we find that customers are deserting the biggest bureaucracy of all, British Telecom, for the newly ordained cable telephone - TV entities that are springing up all over the U.K. And the entrenched U.S. telephone companies, like the British long accustomed to giving the customer what they thought was good for him, have invaded the British cable television universe with a surprising concern that the customer be allowed to choose not only his video entertainment but his telephone service as well. In Germany, the Bundespost moves steadily ahead with a fibre optic system which includes CATV and Telephony, and the well-disciplined customers assume that this is the only way to do it. But the world is indeed changing as elsewhere the customer's voice is heard not only in demand for information services but, as in the former Communist countries of East Europe, for some useful work out of their politicians as well. The problem of how the customer is to find out what is available to him remains, as always, a strange mix of monopoly politics, governmental regulation, impatient engineers and hidden agendas in industry convocations.

The purpose of this discussion is to present the current inter-relationships among three industries which are intrinsically enfranchised monopolies, but are approaching the point where thru the technology of fibre optics any one of them could either become the biggest monopoly of all or simply be displaced by one of the others. Hitherto the principal players have been the telcos and the cable TV industry, each with access to the customer premises within a defined role. Each is building and re-building on a fibre base, in many cases right to the curb but eventually to the home, with the capability of providing all the services of the other.

The character of fibre has introduced the third player, the electric utility industry, with equal access to both customer and capital. As a non-conductive medium, fibre presents no technical obstacle to the combination of electric transmission and communications facilities in a single facility. Thus an electric utility can satisfy its communications needs and distribute its product with the same fibre cable and the same poles. Modest advances have been made in this direction involving telephone carriers but not cable TV companies.

The question emerges, will the competing interests in the use of fibre inhibit the development of a new all purpose infrastructure, as seems to be occurring in the U.S., or will countries such as those represented here with a less mature structure take

advantage of the opportunity to harmonize the uses of fibre to create the optimal information network from the technological, economic and cultural points of view. The scene in the U.S. might be reviewed with some profit to future planners.

TELCO. By the end of 1990 over 3 million fibre miles had been installed by the major long distance carriers and more than that by the Regionla Bell Operating Companies. Rebuild or overbuild, fibre is displacing copper in a series of steps that will eventually reach the home. Experiments with unused capacity proliferate around the nation with the telco in its accustomed role as common carrier but handwriting on the wall in Washington already predicts the change in telco status from common carrier to franchisee or at least to a program service. Depending on legislation, the latter may or may not have the local image or community service responsibilities normally imposed on CATV systems by franchising authorities.

Fibre technology imposes no limitations on what may be carried into the home in the future. The only question seems to be, whose fibre will do it, for while it may be economically questionable for a telco to install fibre simply for telephone and data, the same fibre loaded up with video and indeed electric power transmission might well be an attractive investment for any one of the three industries concerned. So far, the telco industry seems to be furthest ahead in taking initiatives that will lead it beyond its traditional role in response to the challenge of fibre. Proposed legislation, would stimulate that process, unless the CATV industry makes a more appropriate response that it has done to date. Fibre optics bids fair to breach all corporate borders similar to the way communications satellites breached national ones and telcos are the quickest to realize how this affects their future interests. Indeed, Rep. Edward Markey, member of the US Congress, said recently "We will no longer be able to speak in terms of phone companies, or cable companies. They will become part of a larger information industry, including computer manufacturers." His overview has not resulted in any policy proposals to integrate these industries. However, neither has it stopped industry movement toward such integration, as for instance in the southeast portions of the U.S. where telco-cable and telco-electric utilities ventures are probing into all levels of both technology and economics.

CATV. For many years the cable industry has had in place the facilities needed to provide a variety of broad-band interactive services to its customers. This was, and remains, the ultimate promise of cable. Whether due to lack of customer comprehension or lack of cable operators imagination, the promise had not been realized beyond scattered trial runs. The introduction of a 150-channel cable system in New York suggests runaway capacity but a failure of imagination concerning their usage.

The primary objective of cable has been to widen the subscriber base and upgrade the video program service provided. Interactive services, such as the Los Gatos- Hughes and Motorola experiments in California were good for convention seminars but never reached operational status or aroused consumer demand. Distribution of data and voice by cable systems was hardly mentioned until recently and cable's potential in this field within the U.S. was considered so controversial as to be possible under only the most arcane arrangements. As one regulator put it, "go ahead and do it, just don't call it a branch of a cable TV system." Better still, go do it in the U.K. Meanwhile, in pursuit of its primary mission, cable concentrated on video entertainment, launching more and more channels for less and less edifying program material. But 150 channels will surely force the issue of non-video usage.

The more recently built cable systems set about providing dual 400 mz trunk to their franchise area with the concept of using the second trunk or institutional cable, as it is called, for public institutional purposes such as schools, library networks and civil government. In many cases this I-cable has lain fallow, or has been under-utilized. Not surprisingly it has occurred to some that wherever the law allowed and the local telco failed to prevent, high-speed data could be carried on the unused portion of the I-cable both intra and interstate. In the former case state regulation, weighted in favor of telcos, has to be observed and if possible accommodated; in the latter case FCC pre-emption permitted such use, and at least one interexchange carrier has reached a workable formula for the interconnection of a cable system with its long-haul facilities; a customer base has also been defined and orders placed.

This modest beginning of a new traffic and revenue stream for cable systems pre-dated the arrival of optical fibre even on trunks. With cable system re-builds turning to fibre, with capacity far exceeding the available supply of programs and the ability of the viewing public to absorb more video entertainment, it is timely to consider what the more far-sighted cable operators have in mind as they move from trunk to feeder, to curb, and eventually, or inevitably, to home, with the broadest-band system of all.

It may, indeed, be time to hedge one's bets on the cable future. Hughes Aircraft engineers confidently predict the arrival on stream of their Direct Broadcast Satellite for 1994. Three entities with much to lose by this development, Cablevision Systems Corp., NBC and Rupert Murdoch have formed with Hughes the Sky Cable enterprise which will offer 108 channels to anyone with a two-foot dish on his windowsill. What will Cablevision Systems' million-plus subscribers do when they no longer have to tailor their monthly fee to certain packages which contain

channels of no interest to them? What will NBC do to preclude cable multiple system operators from obtaining access to its programs at the expense of local broadcasting stations? And what will program producers come up with to fill 108 channels or indeed 150, whoever controls them? Even including Pay- TV, saturation may have been reached at 75 channels, rather than Sky Cables' 108, and remember that there are at least eight other DBS applicants waiting in the wings, some with affiliated program resources, some without.

Some cable entrepreneurs are, then, hedging their future by joining the DBS, since they can't defeat it, but at the same time they and other multiple system operators are energetically laying fibre as they modernize and rebuild their systems. It would appear that with current access to 85% or more of U.S. homes the basic economics of cable has nowhere to go other than through raising rates, commercial advertising, integrated program ventures and service up-grade.

Pending re-regulation activity in Washington adds to cables' uncertainty in its entertainment business. These and other factors have had a negative impact on the brokerage of cable systems which is expected to increase. It may not be the expectation of constantly rising profits from entertainment that motivates the desire of other-than-cable interests in entering the CATV business. In view of the factors and influences mentioned above, it must be something else. It might even be the potential profit in cable combined with local Personal Communications networks, the proverbial wristwatch mobile telephone. Or it could be the vision of the all-purpose single access to the ultimate user.

ELECTRIC POWER. Enter a third protagonist, the electric utility. In the past, electrical utilities have relied on microwave for their own communications requirements. For technical reasons these companies are beginning to deploy fibre for internal use, often in cooperation with interexchange carriers, where each can offer the other certain advantages, including rights of way and joint use of high voltage transmission lines. Fibre as the first "non-conductive" medium for information transfer in large amounts, offers an irresistible motivation to future large scale integration of initially long-haul power utility and telecommunications distribution. As this development proceeds through legal and policy gestation, the shared use of fibre into the home becomes equally attractive for both economical and technical reasons. This does not mean that either party will necessarily see it as such if one or the other makes the initial installation. A joint deployment, however, may eventually be preferred to a threat of by-pass. In any case, one does not see any telcos or cable companies seeking to acquire electric utilities. Current activity seems to be limited either to mutually defensive moves or to shared use of facilities, with advantages in capital conservation and possible redundancy in the network structure.

If telcos and electric utilities seem to be either at a stand-off or shyly moving toward joint operations, they show no such modesty toward the cable industry. Their interest appears to be to invade cable's turf either by offering the service that cable now provides or by acquiring someone who does. In the case of utilities, acquisition of cable systems, such as Houston Industries buy-out of the Rogers cable systems, was initially a straight business proposition, not an attempt to merge technologies looking to a single access to customer facilities. And yet the very systems Houston acquired are already experimenting with other than video entertainment, such as energy management data distribution and interactive video services. It is reported to be a profitable undertaking and remains unperturbed by regulatory complications. Manhattan Cable has for years
provided data links for the financial community. In New England there are customers for both short and long-haul data circuits, jointly provided by a local cable system and an interechange carrier in a formula which has met competitive but not legal obstruction. The emerging pattern seems clear enough. Telcos and utilities are probably as active in the CATV acquisition game as is anybody else right now. If one asks why, the answer has less to do with the future profitability of cable alone than with access to customer bearing all the services that optical fibre could provide.

One notes that the initiatives of CATV toward common carrier type services, and similar moves by certain electric utilities, based on optical fibre, have been kept at a low profile on the public and regulatory stages. Not so the telco push to provide video program services along with its accustomed role of telephony. Certain trade publications, such as the Cable-Telco Report published by Fred Dawson, are stirring up the imagination of CATV and utilities people who are looking for new economic frontiers. And the telco themselves who have always had a barely-concealed itch to get into show-business, are riding a wave of legislative discontent with the CATV industry by suggesting that competition might solve some of the problems, and that they, the telcos, might be able to do it better. The CATV industry has not yet realized that this argument could work both ways. And the electric utilities' engineers are only beginning to perceive the operating efficiencies and investment economies toward which fibre is leading them, to say nothing about the delights of providing other kinds of entertainment to their customers and investors.

Any predictions regarding the future trend of these developments would entail the usual risk. No one entity is likely to end up as the purveyor of all services to the end customer. The already wasteful overbuild of cable TV facilities is not to be written off in favor of telco initiatives to expand into cable TV-land. Conversely, cable-TV facilities should not lie fallow for lack of a friendly marketing environment. Electric utilities, new to show business but not averse to the profit potential of new technology, seem likely to inch their way into the ring in a cooperative rather than a pre-emptive mode. In the final analysis, the factors of marketing, customer relations, capital formation and technical sophistication will determine the outcome. The predominant industry in the three-sided pattern of the future will be the one that best understands the service path to profit, and the one that is most effective in the gentle art of convincing the regulators of the correctness of its views.

The Year 1992, a period of rapid change, finds these three industries converging at a point in the future that is coming closer all the time. They are like the proverbial three men in a tub, drifting on a sea of regulations but without a rudder. The game will eventually go to the boldest, as ever, and at this stage it would seem that the telcos not only have the advantage but appear to know how best to use it. As Arthur Clarke said, "Science with its usual cheerful indifference, has laid another squalling infant at the doorstep of society." Let us hope that the regulators adopt it, and present us, not with yet another monopoly, but with a healthy new member of the family.

THE IMPACT OF NEW BROADCASTING TECHNOLOGIES ON DEVELOPMENT

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Abstract

The impact of several inter-related new technologies on the development of broadcasting, especially with respect to small and developing countries, is expected to be considerable. Regulatory, policy and technical elements will shape the inevitable introduction of these new technologies, in response to consumer demands. Source, production, delivery and display environments are expected to undergo major changes. The flexibility and resourcefulness of broadcasters and the broadcasting industry will determine how these changes affect them. The work of the CCIR and the CCITT is most intensive in these areas.

Introduction

Broadcasting is at the cross-roads of the 21st Century. Rapid developments in technology will enable delivery of sound and television programs to the home with unprecedented quality, and in the case of sound broadcasting, at lower cost to the broadcaster and listener alike. The consequential rearrangement and renewal of production, distribution and broadcasting facilities will create major changes - comparable to those that took place when FM broadcasting and color television were introduced.

Regulatory and legal aspects will continue to influence the rapidity with which technological innovations bring about real changes, and these vary from country to country and from region to region. But once a new technology is perfected and ready for introduction, there are inevitable pressures for change.

Important technological advances in the following areas are involved:

- High-definition television
- Satellite sound broadcasting directly to home, portable and mobile receivers
- Digital sound broadcasting
- Personal communications
- Microcomputers
- Fibre-optic networks
- Integrated-services digital network (ISDN).

High-definition television

There has been remarkable progress in the development of compressed-bandwidth high-definition television systems during the past two years. This development has resulted in a major reorientation of the activities of the CCIR, where work on developing a system standard for the broadcasting of high-definition television to the general public began in 1974, when Question 27/11 was adopted at the XVth Plenary Assembly.

HDTV has become one of the most charged issues in the international standards-setting arena. The economic success or otherwise of two other high-technology innovations, the broadband integrated services digital network (B-ISDN) and satellite broadcasting, is seen to be closely tied to HDTV, so it is of even greater importance than it would be otherwise. Present trends indicate that HDTV will be introduced into the home during a transition period that is equal to or longer than the transition period between monochrome and color television. It is likely that the B-ISDN will be widely available before HDTV is commonly accepted, but the introduction of broadband subscriber loops may take place in parallel. The B-ISDN and broadband subscriber access will also provide a friendly environment for the delivery of conventional television programs. The questions of cost and readiness of subscribers to pick up the tab have to be resolved.

Standards

The CCIR is the centre of worldwide standardization efforts in developing the HDTV system of the 21st Century. In 1985 a proposed world standard for the studio was considered based on 2:1 interlaced scanning with 1125 lines and a field rate of 60 Hz. An aspect ratio of 16:9 was proposed, requiring 1920 luminance samples per active line, and 960 color difference samples [Ishida and Nishizawa]. Awakening commercial interest in HDTV in different regions of the world led to an

alternative proposal in 1987 for a system using 1250 lines, 50 Hz progressive scanning* [Wassiczek, Waters and Wood].

There are four inter-related areas for standardization in television: studio standards, exchange standards (including recording and transmission), emission standards and display standards. Considerable benefits would accrue, particularly to the global public, if a single world-wide family of easily-convertible standards, applicable to the production, transmission and emission media (satellite and terrestrial) were available. The resulting economies of scale in the production and delivery of programs as well as in the production of receivers offer the possibilities of major benefits to all of the participating elements, from program producer to viewer and would open vast markets to manufacturers.

The XVIIth CCIR Plenary Assembly (Düsseldorf-Neuss, 1990) adopted Recommendation 709 which lists all parameters necessary for the definition of the HDTV studio signal. A few key parameters, including picture rate, remain to be agreed. Continuing conflicting interests among its members have prevented the CCIR from agreeing on a studio standard. Four other Recommendations related to HDTV, including recording and exchange standards, were adopted.

Delivery means

Terrestrial emission remains by far the principal means for delivery of television to the home. Because of lack of additional spectrum in densely-populated areas, terrestrial emission of HDTV will require considerable bandwidth compression of the studio signal.

Satellite emission means are particularly attractive to provide wide bandwidths for HDTV, and coverage of large geographic areas can be achieved very quickly. Direct satellite broadcasting using high- and medium-power satellites is foreseen as the principal means for broadcasters to introduce HDTV in those countries where broadcasting is mainly carried out on a national basis and there are few local television broadcasters.

Video cassettes and optical disk recording will be important elements in the HDTV marketplace. Home-market VCRs are in an advanced state of development, and the progress towards a read-write optical disk recorder could revolutionize television signal recording.

Cable systems, including the B-ISDN, will offer high-quality, high-capacity means for the delivery of HDTV to the home. Indeed, the economic viability of broadband services delivered to the home will likely depend largely upon television.

Regional approaches

JAPAN

Japan started in earnest to develop HDTV systems following the adoption of Question 27/11 in the CCIR in 1974. NHK laboratories had progressed to the point of implementation of a system design, including prototype hardware, by the time of the XVIth CCIR Plenary Assembly (Dubrovnik, 1986).

At that time, Japan was concentrating on developing a completely new, premium service (both in terms of technical quality and programming) for delivery by satellite. Hence, the newly-developed system did not require compatibility with the existing NTSC system.

In addition to the studio hardware (cameras, VTRs, etc.), the Japanese designed and implemented bandwidth-compressed analogue delivery systems under the acronym MUSE (***MU**ltiple sub-Nyquist Sampling **E**ncoding*). Daily experimental satellite broadcasting for one hour each day with the MUSE system started in June 1989, using the same type of receiving antenna and outdoor unit as used for satellite broadcasting in Japan with the digital subcarrier/NTSC system. The BS-2b satellite was initially used for this purpose, followed by BS-3a. Extended operations started in 1991 using an exclusive transponder of the BS-3b satellite [Ishida and Nishizawa].

In the short time since broadcasting of conventional television by satellite was introduced in Japan, using an emission format based on the existing NTSC system, it has gained widespread popularity among the viewing public, with well over a million homes receiving the satellite emissions.

Japan has made a policy decision to introduce enhanced television *(EDTV)* for terrestrial emission and high definition television *(HDTV)* for satellite emission. [Kawauchi].

EDTV in Japan must fit within the 6 MHz band allocated for terrestrial television and must be compatible with the NTSC system. First-generation EDTV includes ghost cancellation, quasi-constant

* Initially implemented with 2:1 interlaced scanning

luminance signal processing, adaptive pre-emphasis of high frequency components in the luminance signal, higher-resolution signal sources, 525-line progressive-scan display and three-dimensional Y/C separation. This service was started in mid-1989 and is now operational in most Japanese television stations.

Second-generation EDTV in Japan is under consideration in the Telecommunication Technology Council.

EUROPE

Several European countries, in adopting the MAC/packet family of standards, established a step-by-step approach in improving the technical quality of the television signal delivered to the home. Largely developed for satellite broadcasting and cable distribution, the MAC/packet formats are not compatible with existing PAL and SECAM systems and therefore require new receiving equipment. The second step in the MAC approach is HD-MAC, which will provide a compatible transition from MAC/packet systems to HDTV. There is currently a major intensive design and development effort on the part of European industry in this area, known as *EUREKA-95*.

MAC/packet broadcasting provides noticeable signal improvements over PAL and SECAM systems and offers wide-screen possibilities, but retains 625-line resolution. D2-MAC/packet emission is presently used with the high-power broadcasting-satellite service (BSS) satellites TDF-1 and -2 (France) and TVSat-2 (Germany) [Wassiczek, Waters and Wood].

The 16-channel European-coverage television satellites *Astra* carry channels intended for direct reception using the conventional PAL system. These 12 GHz-band systems generally operate with home receiving antennas of 60 cm diameter, or less. Distribution of television and sound broadcasting programs via satellite has become very popular in Europe, with a large number of programs also available on EUTELSAT and INTELSAT satellites, in addition to national and private satellites already operating or planned for operation in the near future. As in North America, most of these satellites operate in the fixed-satellite service (FSS) and their signals are intended for distribution of television and sound broadcasting programs, principally to cable systems, but numerous direct-reception installations have been made.

The Astra services are indicative of the many private operators now coming on the scene in Europe. Since the intention in Europe has been to provide HDTV as a new service disseminated by satellite and cable systems, little attention has been given to the problem of how to introduce HDTV for terrestrial emission. The advent of new terrestrial broadcasters has precipitated considerable re-thinking in this area. Although recent studies indicate that the D2-MAC system will operate successfully in the terrestrial environment with the addition of an echo canceller, the MAC/packet systems are not compatible with PAL and SECAM receivers [Schachlbauer]. Intensive work has been going on during the past two years to develop an improved PAL system, called PALplus, that is compatible with PAL. Compatibility with the conventional PAL system is maintained.

A new pan-European research project is proposed to develop techniques that can be applied to digital HDTV [Baum]. The project, under the acronym VADIS *(Video-Audio Digital Interactive System)*, is to develop technology within the framework of the Eureka 625 project for compressing the digital television signal for conventional 625-line television by a much greater factor than has been achieved until now. More than 30 organizations from 12 different European countries have agreed to cooperate to develop the source coding technology needed for all-digital television. Some European private broadcasters who wish to see digital television emission pursued more vigorously view this project as an important step in that direction. The system is to be designed to enable expansion to high definition television.

NORTH AMERICA

The direct reception of FSS television transmission first gained wide-spread popularity in North America, where a large number of 6/4 GHz band systems are available to cable system operators and to the general public. Recently, the introduction of 12 GHz band systems has enabled the targeting of specific service areas with higher-power signals, so that the home receiver antenna diameter becomes quite small. The encryption or scrambling of satellite television services, either to protect copyrights or for pay-television services, is becoming more widespread, and is now being introduced in Europe as well as in North America. These techniques are equally applicable to HDTV and most new systems are designed to provide scrambling capabilities.

The configuration of television broadcasting in the United States, which is based on local television broadcasters, depends upon terrestrial emission. Hence, much of the development work aimed at the terrestrial broadcasting of HDTV is taking place in the United States. It is essential for broadcasters to maintain the continuity of service to existing receivers. Conventional and HDTV emissions will therefore have to co-exist during a long transition period. Since available spectrum is limited in most population centres, the possibilities for spectrum-efficient emission formats have been emphasized.

Since 1982, the Advanced Television Systems Committee (ATSC) has provided the framework for the development of advanced television systems in the United States, including HDTV. The ATSC set up working groups to study and recommend standards for studio production; for terrestrial, satellite and cable distribution and for consumer displays [Hopkins and Davies].

Following the submission of proposals to the CCIR in 1985 and 1986 to adopt a single studio production standard based on the design originally developed by NHK of Japan, interest in HDTV was considerably hightened in the United States. The Federal Communications Commission (FCC) set up a broadly-based blue-ribbon industry advisory committee on HDTV.

Decisions of the FCC taken since 1988 indicate that there should be a terrestrial HDTV service for the United States and require that viewers with NTSC shall not be disadvantaged by the new HDTV service. The FCC also has stated its intention to use the existing terrestrial TV emission bands and that each existing TV licensee could be allocated up to an additional 6 MHz of spectrum. These decisions have resulted in intensive efforts by industry to develop an HDTV emission system that is highly bandwidth-efficient. Subsequent decisions by the FCC that NTSC augmentation approaches requiring additional spectrum would not be considered further and that simulcast would be preferred have served to further focus the development efforts [Miller].

Meanwhile, as many as 21 different proposals were submitted to the FCC for new systems. An Advanced Television Test Center (ATTC) was set up by the major broadcast associations, the major television networks, the Electronic Industries Association (EIA) and cable television interests to conduct tests of the various proposed systems. Canada is also participating actively.

During the time since the ATTC was formed, two major developments have served as catalysts to completely change the direction of the evolving system. The first of these was the proposed hybrid analogue/digital simulcast proposal from Zenith that used a 6 MHz bandwidth [Luplow and Fockens]. The second was the last-minute proposal by General Instruments (VideoCipher Division) for a fully-digital emission system within a 6 MHz bandwidth [Heller and Paik].

As a result of these proposals, and the perceived quality of the all-digital simulated systems, a number of proponents of new systems have either joined forces with others, or have dropped out of the competition altogether. Four of the five remaining proponent groups have modified their proposals to offer full digital emission and the fifth provides for full digital processing in both the transmitter and receiver, but with analogue emission.

Intensive work on enhancements to improve NTSC systems is also in progress in the United States and Japan [Uyttendaele], but has been somewhat overshadowed by the work on bandwidth-compressed HDTV.

Status of the CCIR work

Meetings of the Task Groups and Working Parties of the CCIR that are dealing with HDTV were held in Geneva in November 1991. While no major progress was made in breaking the log jam that has prevented agreement on a global HDTV production standard since 1986, further progress was made towards a satellite emission standard, and work started in earnest on a terrestrial emission standard.

In this regard, a draft new Question on digital terrestrial television broadcasting was drafted and proposed by Australia for approval by correspondence.

The objective of this new Question is to stimulate the CCIR studies to determine "...what bit rate reduction coding method(s) which can form a single, flexible algorithm (or small group of related algorithms) should be used for terrestrial emission". The studies are to include the "...appropriate modulation and emission methods and their relevant parameters, for the broadcasting of digitally encoded TV signals in terrestrial channels". Finally, the studies will address "...the appropriate strategies to introduce and implement digital terrestrial TV broadcasting services, taking account of existing terrestrial broadcasting services".

Once this new Question is approved, probably by the end of January 1992, a new Task Group (TG 11/3) will be set up to prepare appropriate Recommendations on the study topics. Mr. Stan Baron (NBC, USA) will be designated as Chairman.

A second development of the 1991 CCIR meetings concerning HDTV came from Working Party 10-11S of the CCIR, which deals with satellite broadcasting. Three draft new Recommendations were adopted on HDTV: *1)* Coding rate for wide RF band HDTV broadcasting-satellite service, *2)* MUSE system for HDTV broadcasting-satellite services and *3)* MAC/packet based system for HDTV broadcasting-satellite services. These will be forwarded for consideration by Study Group 11 during its meeting in May 1992, for subsequent adoption by correspondence.

Future trends

Rapid developments in digital techniques, coupled with falling costs, will allow complex image analysis and processing in the studio and complementary synthesis in the receiver, together with efficient means of long-distance transmission and broadcasting. The historical dependence of studio and receiver scanning standards will ultimately disappear.

Digital equipment is being introduced in various parts of existing broadcasting chains, much of which is in accordance with CCIR Recommendation 601 on the digital studio standard for conventional television systems. The CCIR has recognized that the long-term future of HDTV lies in the digital domain [Nickelson].

It seems unlikely that a single emission standard, either in terms of quality or technical parameters, could be developed for economical use in all applications: source and production media, delivery media, diverse users. On the other hand, a world-wide family of standards should be achievable, if the Study Group 11 approach to a unified world-wide digital HDTV studio standard is followed.

The quality of the highly-compressed digital emission systems presently under development has surprised many specialists, who, until very recently, were predicting that it would take many years to perfect such systems. Digital emission systems offer the additional advantages of better performance and superior immunity to interference at significantly lower transmitter powers, and with less complex antenna systems. The savings in installation and operating costs are expected to be considerable.

If the rigorous test programs planned for the United States and Canada during the next year verify the simulated results, then terrestrial emission of HDTV may begin much sooner than had been expected only a year or two ago.

The implications are considerable for the program producer, the broadcaster and the viewer. Early viewer tests of enhanced and high definition television equipment that produced negative results were found to use converted conventional television source signals, or inferior-quality cinema film stock. This serves to illustrate the necessity of having available a complete chain of HDTV production, switching, transmission and emission equipment when these services begin. Wide aspect ratios, whether in enhanced systems or HDTV, present new problems that have to be dealt with.

This year's Montreux symposium devoted considerable time to discussion of the impact of wide-spread use of letterbox techniques to accommodate the wide-screen format on conventional aspect-ratio displays when simulcasting is done [Reimers]. Where the majority of TV receivers have a small screen (e.g., 50 cm), the viewers may have available a picture that is equivalent to that of a 36 cm display when receiving simulcast productions that originate in the 16:9 aspect ratio. Some argue that this may serve to make the viewer more aware that large-screen, wide-screen television is available, but others argue that it will only serve to annoy the majority of viewers.

Other aspects also have to be taken into account. Television production is becoming increasingly mobile. Outside-broadcast and satellite-news gathering facilities have gained wide-spread popularity among broadcasters. The CCIR has undertaken to extend Recommendation 722 on satellite news gathering to encompass HDTV.

Impact on development

The introduction of HDTV will be a costly affair, even in the most advanced industrialized countries.

Twenty years ago, when the Satellite Instructional Television Experiment (SITE) was being prepared in India, a debate was raging in the developing countries concerning whether or not television could ever be a cost-effective medium for development. The results of SITE did not resolve that debate [UNESCO], but subsequent launch and operation of the Indian National Satellite system (INSAT) and dedicated satellite communication

systems in other developing countries have proven the utility of such systems. At the same time, color television was considered prohibitively expensive for developing countries. In spite of the costs, many developing countries, including India, have introduced color television emissions as standard.

Similar arguments are valid for HDTV. In the long run, in spite of the high costs, HDTV will inevitably find its way to developing countries.

Having decided that, it then becomes necessary to consider how the cost impact can be minimized. The experience being gained in the industrialized countries will be invaluable in this regard.

Even more so in developing countries than in the industrialized ones, television is a radiocommunication medium. The existing installations of expensive television receivers may be expected to be in use *and to continue to increase in number* for many years after the introduction of HDTV. (Monochrome receiver sales are still significant in developing countries that have color television emissions available.) Consequently, the introduction of HDTV must not disrupt the existing television system.

When color television was introduced, downward compatibility was considered mandatory (i.e., existing receivers could display color emissions in monochrome without objectionable degradation). The HDTV emission systems proposed in Japan, Europe and North America all recognize that HDTV is a new, superior quality service and therefore do not provide for downward compatibility. This means that additional emission facilities will have to be provided for HDTV, if standard TV emissions are to continue for some time. Systems that require lower power and less complex antennas are therefore preferred.

Program production costs, which are already higher for color programs than for monochrome, will again be higher for HDTV. Thus, locally-originated programs may be expected to use color and HDTV production techniques only as financing becomes available to cover the additional costs. Programming that is especially amenable to HDTV with minimal additional investment in studio equipment, such as sports contests, parades and outdoor musical performances in high natural ambient lighting conditions, will initially be preferred.

HDTV is recognized as being spectrum-hungry. To support simultaneous HDTV and conventional emissions of the same programming will require a minimum of twice the presently-used bandwidth, if the approach now proposed in the United States is followed. Previously-proposed approaches would require even more. Since television broadcasting is not extensive in most developing countries, this is seen to be a secondary consideration.

Satellite sound broadcasting

A new technology that is just beginning to attract the attention of broadcasters and the public is direct satellite sound broadcasting. Intensive work by the members of the European Broadcasting Union (EBU) and others has resulted in major system proposals and feasibility demonstrations to the CCIR and during ITU Administrative Radio Conferences.

All-digital spread-spectrum systems operating in the UHF band can provide wide-area multi-program coverage of high-quality stereophonic sound broadcasting programs. Reception in homes, moving vehicles and to small portable receivers has been demonstrated. These systems combine the wide-area coverage advantages of HF broadcasting with the quality of VHF FM-band broadcasting services, and can easily include data-broadcasting capabilities.

Similar, compatible, terrestrial systems can provide additional coverage.

The development of reliable, low-cost receivers and antennas will be an important element in implementing these systems. Considerable development work has already been done, but additional improvements will be beneficial.

Consideration of the allocation of a band for this service is on the agenda of the 1992 World Administrative Radio Conference that will be held in Spain. Similarly, the allocation of a band for the world-wide satellite broadcasting of wide RF band high definition television is to be considered by that conference.

Impact on development

Sound broadcasting from satellites direct to fixed, portable and mobile receivers offers the advantages of both HF and FM sound broadcasting, (wide-area coverage and high quality) but without the disadvantages of either (very poor quality and limited coverage area, respectively).

Members of the EBU are enthusiastic about the possibilities offered by this new technology to provide continent-wide coverage of high-quality

broadcasting services. This will enable listeners to receive their home programs wherever they travel or live in Europe.

Great potential also exists for developing countries to provide national sound broadcasting coverage in a very short time frame for information, education and entertainment programs without developing the costly and extensive broadcasting infrastructure now required. Systems are already being proposed that will offer service to a number of broadcasters from a common space station [Samara].

Status of the CCIR work

The meeting of CCIR Working Party 10-11S in November 1991 approved a draft new Recommendation on digital sound broadcasting to vehicular, portable and fixed receivers for the BSS (sound) in the frequency range 500 - 3000 MHz to be forwarded for consideration by Study Group 11 during its meeting in May 1992, for subsequent adoption by correspondence.

Personal communications

Personal communications is a new technology that potentially may have more impact upon broadcasting, as we know it today, than any of the other new technologies. The convenience, potential low cost and consequent universal availability of personal communication stations will place an enormous demand on the radiocommunication spectrum. Frequencies that are most advantageous for broadcasting are also highly advantageous for personal communications. Demands are already growing rapidly, as evidenced by the decision to hold a World Administrative Radio Conference in Spain in the first quarter of 1992 to deal with a number of mobile radiocommunication issues. The combined consequences of fibre optic ISDN networks and personal communications could result in major changes in the way sound and television programs are delivered to their audiences.

Microcomputers

Microcomputers have become a part of everyday life in most businesses and educational institutions and are found in many homes. Since video display units used with microcomputers and television displays have many common aspects, the digital world of the 21st Century will witness a continuing convergence of the system design and manufacturing technologies used to implement these displays. The use of the same display for the two different functions will not be universal, or even common, by any means. HDTV, in particular, will demand large, wide-screen displays with a diagonal dimension of one metre or more, whereas microcomputer displays, which are used at much closer range, will generally remain modest in size. Nevertheless, economies in production and flexibility in use will tend to encourage the development of displays that function well in both environments.

Fibre-optic networks

The dramatic improvements in the cost-per-bit of information carried on fibre optic systems that have occurred during the past 10 years continue. The quality of such systems sets the standard towards which other, competitive systems, strive. Where costs and quality improvements are advantageous, the industrialized countries are rapidly replacing copper-based coaxial cable networks, microwave and satellite links with fibre-optic systems. The next step in the chain - the link to the home - has been technologically feasible for some time now, but cost and regulatory considerations have delayed its introduction.

To be cost-effective, the fibre-optic subscriber loop will have to carry broadband services, i.e., television. On the one hand, general introduction of fibre-optic subscriber loops carrying broadband services will completely change the concept of broadcasting. Complex issues of competition, sharing of revenues, and even the fundamental way in which programming is prepared, distributed and viewed will have to be addressed. On the other hand, and assuming eventual wide-spread availability of fibre-optic subscriber loops in national telecommunication networks, significant numbers of viewers and listeners will never be reached by this medium. This is especially true in countries with large geographic areas, in areas of sparse population density, and in areas of difficult, unfavourable terrain.

The issues affecting fibre-optic systems are inter-related with several of the other new-technology areas.

Integrated-services digital network (ISDN)

1991 marked the bicentennial of the communication protocol, for it was in 1791 that Claude Chappe conceived and built the first optical telegraph in France, which included procedures for exchange of messages between the operators to provide for flow and error control. It is quite appropriate that we take note of this advance in technology in the service of mankind, just at the

dawn of the era of digital telecommunications – as exemplified by the integrated services digital network (ISDN).

Strictly-speaking, the ISDN can use any of the available carrier technology media - coaxial cables, fibre optics, microwaves, satellites. Recently, emphasis has shifted from implementation of the ISDN to the broadband ISDN. In this context, fibre-optic technology becomes even more attractive. Advanced microwave and satellite systems will also provide major links in future B-ISDN networks. Whatever the technology used in B-ISDN networks, the enormous capacity and flexibility available will enable unprecedented possibilities to exchange and distribute television and sound broadcasting programs, and to deliver them selectively to broadband subscriber drops. In this context, it will be possible to originate television and other broadband services from any point within the network where two-way fibre-optic subscriber loops exist, thereby vastly widening the possible sources of television and other broadband services, when compared with today's network.

Conclusions

High-definition television, satellite sound broadcasting, data broadcasting and other new capabilities that will be available in the world of broadcasting in the 21st Century will develop in delivery environments that may be considerably different from those that have been used since the inception of broadcasting. Rearrangement of production and delivery means will have far-reaching consequences in the broadcasting industry, and indeed in telecommunication and computer industries, as well. Regulatory environments will affect the timing and extent of these changes, but the pressures resulting from the combination of available technology with consumer demand will eventually result in major rearrangements taking place, as has already occurred as a consequence of the introduction of video recording and satellite transmission technologies. The replacement of most of the world's radio and television receivers, as well as most production, transmission and emission facilities, during the next two decades, as the new technologies are accepted by the public, will support major manufacturing industries. There will clearly be major impact on broadcasters and the broadcasting industry, but those who adapt to and embrace the new technologies will flourish.

Sound broadcasting may be expected to undergo similar far-reaching changes, as digital broadcasting is introduced, both terrestrially and via satellite. There will undoubtedly be a transition period of many years before the new digitally-based services supplant existing FM-VHF services, which themselves took many years to equal the popularity of AM medium-wave sound broadcasting services. Superior quality and wide coverage areas are advantages that these new services may be expected to exploit.

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He was a member of the staff of the Lincoln Laboratory of the Massachusetts Institute of Technology (MIT) and participated in the joint design study for the Indian National Satellite *(INSAT)* conducted by MIT and the Indian Space Research Organisation *(ISRO)*. He joined ITU in 1971 as Technical Coordinator for the Satellite Instructional Television Experiment *(SITE)* in Ahmedabad (India). In 1976 he was transferred to Geneva, where he worked as a Project Officer in the ITU Technical Cooperation Department. In 1980, he was assigned as ITU Study Manager for the ITU project on development of rural telecommunications in Africa. He was appointed to his present position in 1981. He is a member of the scientific *Society of the Sigma Xi* and the IEEE *Communications Society*.

The Possibility of Unified Legal Infrastructure on Electronic Information Transfer (Communications in General)

--- covering the both of television broadcast distribution services and visual telecommunications interactive services

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Abstract

Primarily introduced and reviewed is an overall conceptual block diagram of information infrastructures combining telecommunication networks and information service centers such as broadcast program centers. Then two two-dimensional expression maps of information handling service/business alignment are issued from service end-users' standpoint. Presented in connection with them are the description trials on telecommunication service quoting to Maxwell's electromagnetic equations, broadcast service, etc.

Possible unified legal infrastructure composition for electronic information transfer, and possibility of "local and public information alley" deployment are proposed as further study items and discussed, following to a brief review of current telecommunication/broadcast-relevant regulations (centering on Japan's case).

1. Introduction---Information Infrastructures combining Telecommunication Networks and Information Service Centers such as Broadcast Program Centers

Recently a technical possibility (and reality in some countries) of "direct broadcast satellite (DBS) type" end-user receiving service by utilizing TV program distribution via communications satellite (CS) for local broadcast facilities became well accepted. Furthermore attentions are drawn to another technically mature possibility where Optical-Fiber Cable System for B-ISDN end-user access (so-called Fiber-to-the-Home, FTTH/C/P) is commonly applied to the multiple kind of services such as telephone, computer communications, television telephone, and cable television (CATV).

The above two cases are concerned about the combination of (1) "one to very large N (one way)" distribution service of TV broadcast program to many and wide-spread service users, and (2) conventional visual (tele)communications services where audio-visual (including motion picture type) information is transferred in "one-to-n (one way)" mode or in "one-to-one (two way)" mode.

Here a conceptual block diagram of information infrastructure, Fig. 1 (Ref. 1) is introduced as the basis of more balanced observation of the problem from a generic end-user's view point. It can be seen that the above two cases are related to the practical implementation of service users connection subsystem in front of external interface for (transmission and) receiving equipment of service end-user premises.

Table 1 shows, further, the comparison of various "service end-user connection (sub-) systems" in terms of "service mode versus transmission media" combination. These subsystems can be also described in more detail as "Direct Connection (Sub-)System for Public Service End-User Interface". Table 2 summarizes the current concrete implementation modes of principal service end-user subsystems.

Referring to Fig. 1 in association with Tables 1 and 2, it seems obvious that the above-raised technical possibilities (realities) must be understood as the important two possible sophisticated technical triggers, among others, to the rather systematic evolution of traditional discipline of information handling-relevant business operation.

This paper reports relevant preliminary observation results and further study item proposals, based upon a rather end-users standpoint.

They are initiated from the technical side, but extended to service/business alignment. They further reach legal infrastructure reconsideration. They are aiming to pursue the futuristic matching of technical trends and social discipline in IT (Information Technology)-relevant arena, avoiding rather rash thought towards too much simplified "conflict coordination" and so-called "convergence" between broadcast business and telecommunication business.

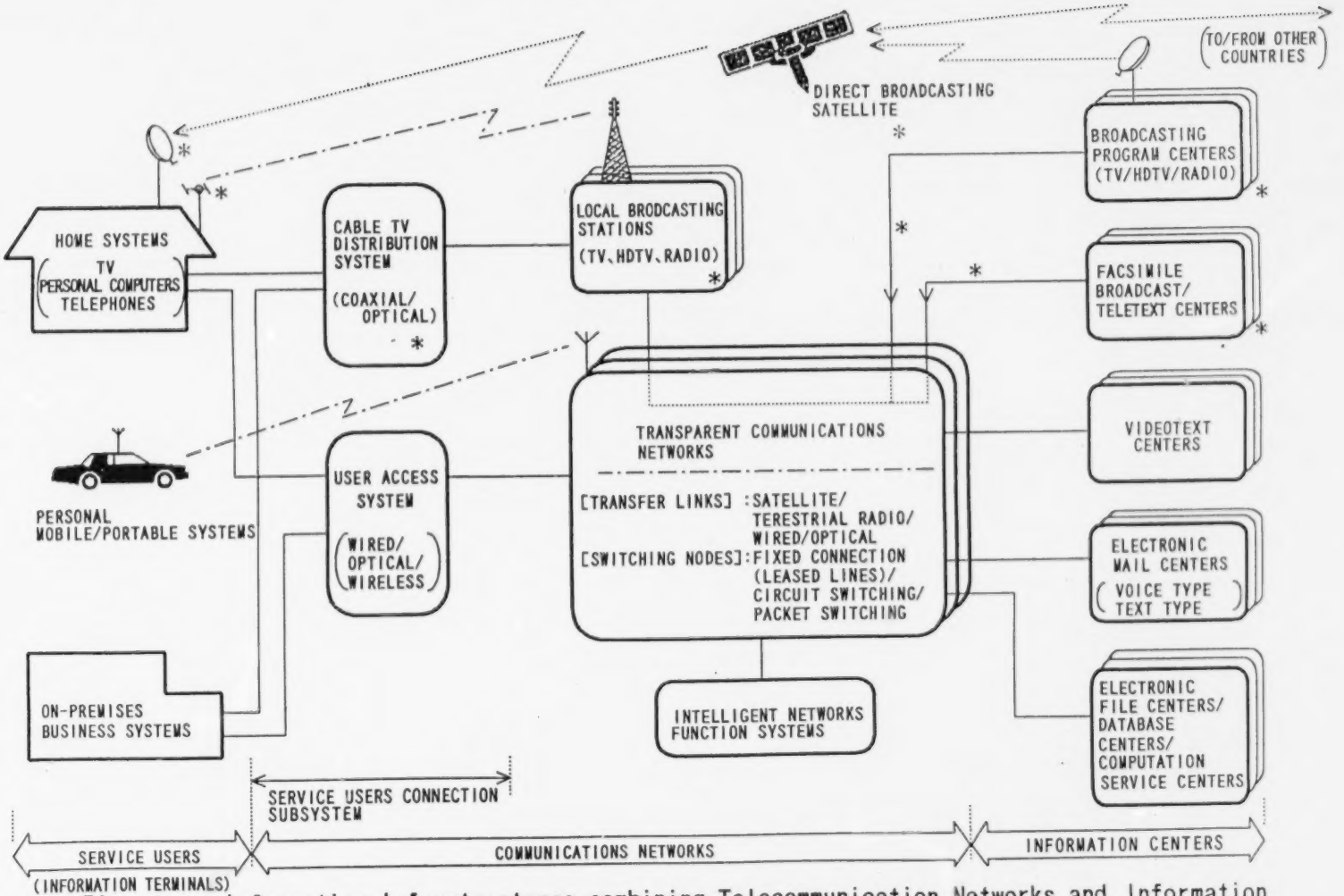


Fig. 1 Information Infrastructures combining Telecommunication Networks and Information Service Centers such as Broadcast Program Centers
(* marks indicates broadcast-relevant facilities)

Table 1. Comparison of Various Service End-User Connection Systems

Transmission Media \ Service Mode		TV Program Distribution to end-receiver (1 to N)	Access to Transport Network from telephone type service end user (1 to 1)	Common Connection of service users to broadcast/ telephone type systems
Wired System	Twisted Copper Wire (Star Net)	x	0	x
	Coaxial Cable (Tree Net)	0	x	x
	Optical Fiber (FTTH)	0	0	0
Wireless System	Terrestrial Radio Wave	0	0	x
	Satellite-utilizing Radio Wave	0 Capacity Limited	Δ Future Possibility Capacity Limited	x Impossiblity of simultaneous common use of the same wave channel

○: Possible
×: Impractical
Δ: Conditionally Possible

Table 2. Principal Systems for Service End-User Connection

		Communication	Broadcast
Wired System	Twisted Copper Cable	Public switched telephone, leased line, N-ISDN	
	Optical Fiber Cable	Public switched telephone, leased line, N-ISDN, B-ISDN	(CATV)
	Coaxial Cable		CATV
Wireless System	Terrestrial Radio	800MHz etc⋯⋯Mobile Telephone, Portable Telephone, MCA	VHF/UHF⋯⋯Television Broadcast HF etc ⋯⋯Radio Broadcast
	Satellite-utilizing Radio	Ku, Ka Band⋯⋯Conventional Satellite Communications	12GHz Band⋯⋯DBS

2. Various Information Handling Service Business Alignment from the Service End-Users' Standpoint

2.1 Free Description Trials on Telecommunication Service, Broadcast Service, etc.

Fig. 2 illustrates the interrelation of the basic information handling services/business including broadcast and telecommunication, expressed in a map of "information handling functions versus media technology varieties". Here, in horizontal axis, five fundamental information handling functions of human society are listed. Three inside-described functions: information transfer, information memory and information processing, withdrawing the remaining two at the both end sides (i.e. presentation and creation), are considered as the fundamental functional elements of information service system in general (Ref. 1). They correspond therefore to the fundamental electronic information handling functionalities of IT (Information Technology) Industry Complex, too (Ref. 2).

In vertical axis, not only electromagnetic/ electronic information media technologies applications but also paper media-utilization and direct human-to-human (face-to-face) contact are listed for reference/comparison.

Referring to this Fig. 2, an IT engineer's free description trials (a basis of definition) of telecommunication and broadcast are shown below. These descriptions are made "naturally" being independent to the historical considerations reflected in the current legal infrastructure on telecommunication and broadcast in many developed countries. They are based upon the standpoint of service end-users, i.e. generally laymen.

(1) Description of Telecommunication

Referring to the horizontal axis of Fig. 2, let us pay attentions to "information transfer" function, i.e., information circulation between information source and destination which are located distantly.

It is proposed to adapt the following as the generic description of (electromagnetic/ electronic) telecommunication:

. "Service function to transfer information in the form of generation and detection at information source and destination respectively, utilizing electromagnetic and/or electronic phenomena in a broad sense which are based upon Maxwell's electromagnetic equations".

It is important that the both of wired communication and radio (wireless) communication are included in the scope of the above description.

Furthermore, the electromagnetic phenomena application for information memory and presentation functions in combination with information transfer are also considered as included in the above scope. This is corresponding to the short and fat rectangular box expression of single-solid line: Telecommunication Service Business.

It is also essential that the information content is kept free from error and distortion in telecommunication. The expression "transparent communication" is utilized to emphasize this requirement. It is further important that information is transferred from right information source to right destination on-demand basis in real time mode (immediately). To do this, the functions of switching, transmission-channel-cross-connect and selection which is to be facilitated in nodes of telecommunication network. Those functions must be combined with fundamental wired/radio transmission (See Transparent Communication Network of Fig. 1).

(Tele)communication (service) business is described as the business to mediate telecommunication among other parties or to provide with telecommunication facilities for communication (information transfer) of other parties. The other parties, i.e. telecommunication service users, in this case, include distinctly not only general service end-users but also information service providers (center-users) (See Fig. 1).

The other parties' information contents are supposed to be not processed nor disturbed nor broken their privacy in telecommunication service business. Here, the principle of communication privacy: "information as the service objective must reach only the receiving side pre-specified by transmitting side" should be assured and guaranteed. This is obviously corresponding to the expansion of a fundamental constitutional right: "freedom of private correspondence exchange" or "freedom of privacy in communication", towards telecommunication services (Ref. 3). The principle is often quoted as "freedom of (tele-)communication" or "privacy of (tele-)communication". This is of course a basis of democracy.

(2) Description of Broadcast

The following sets of information handling functions combination in human social activities are something essential for information-intensified society:-

(a) Gathering, producing (creating) and/or editing/aligning use-worth informations/knowledges systematically and freely, and
(b) Transferring and distribution those

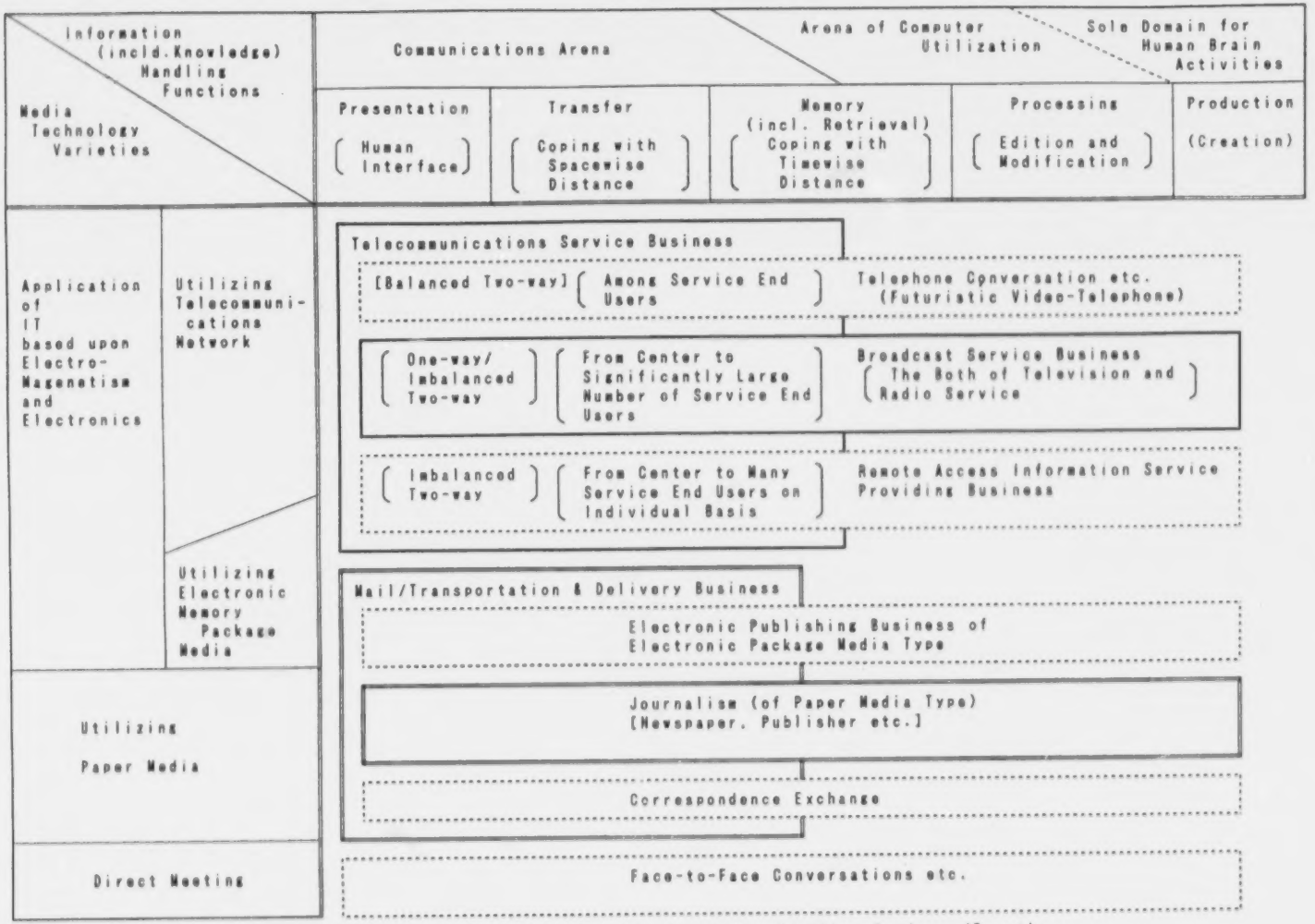

Information (incld.Knowledge) Handling Functions
Media Technology Varieties
Communications Arena
Arena of Computer Utilization
Sole Domain for Human Brain Activities
Presentation
(Human Interface)
Transfer
(Coping with Spacewise Distance)
Memory (incl. Retrieval)
(Coping with Timewise Distance)
Processing
(Edition and Modification)
Production
(Creation)
Application of IT based upon Electro-Magnetism and Electronics
Utilizing Telecommunications Network
Utilizing Electronic Memory Package Media
Utilizing Paper Media
Direct Meeting
Telecommunications Service Business
[Balanced Two-way] (Among Service End Users)
Telephone Conversation etc.
(Futuristic Video-Telephone)
(One-way/ Imbalanced Two-way)
(From Center to Significantly Large Number of Service End Users)
Broadcast Service Business
(The Both of Television and Radio Service)
(Imbalanced Two-way)
(From Center to Many Service End Users on Individual Basis)
Remote Access Information Service Providing Business
Mail/Transportation & Delivery Business
Electronic Publishing Business of Electronic Package Media Type
Journalism (of Paper Media Type)
[Newspaper, Publisher etc.]
Correspondence Exchange
Face-to-Face Conversations etc.

Fig. 2 Interrelation of Basic Information Handling Business/Function
- from the Service End-User's Standpoint -

organized information/knowledges, on real time basis or just in time to very large number of people, in the simultaneous and public mode.

Traditional implementation examples of those kinds are journalism (periodicals including newspapers and book-publishing), theater performance and exhibitions.

Broadcast can be interpreted as the combination of the above (a) and also the above (b) in which already above "described" telecommunication functions are utilized. Then the functions of broadcast are divided into two fundamental portions and quoted as:

(a') broadcast program edition
(b') broadcast program distribution.

Here, it is obvious that the principle of "freedom of broadcast" is as important as the principle of "privacy of (tele-)communication" discussed in the above (1) (Ref. 3). The essence of this "freedom of broadcast" is the "freedom of broadcast program edition". In connection with the special telecommunication measures for transparent distribution of edited program (information/knowledges) to be made public, the ordinary freedom of reserving "privacy of telecommunication" is naturally replaced by the "freedom of public information distribution to very large number of service end-users" based upon the free will of information transmission/origination side.

This "freedom of broadcast (program edition)" is obviously corresponding to a fundamental constitutional right: "freedom of press/publication" (Ref. 3).

The business composed of the above (a') broadcast program edition and (b') broadcast program distribution can be called as "broadcast (service) business". However, broadcast business operators, i.e. broadcasters by themselves, do not necessarily produce/edit all the broadcast programs to be distributed, the objective of the above (b'). They by themselves do not necessarily distribute all the broadcast program to be produced, that is, the objective of the above (a').

Quoting to the thin and flat box expression of single solid line in Fig. 2, the fundamentally important and necessary function of broadcast service and broadcast (service) business is to produce, to edit and to store good broadcast programs which are attractive to service end-users. This essential function of broadcast is corresponding to the above (a') and situated at the outside of conventional telecommunication (electronic information transfer) functionality domain discussed in (1).

It is also worth to the emphasis that the function of live direct broadcast program composition is included as the indispensable/necessary portion of the above (a'): broadcast program edition. This subfunction cannot be replaced by any other public media such as electronic memory package media (See Fig. 2).

Historically speaking, the above (b') function: broadcast program distribution was originally implemented in the form of terrestrial radio communication facilities. Later, CATV approach and DBS approach became in service. Now, the possible common utilization of FTTH between telecommunication business and broadcast business is issued (See Fig. 1). All kinds of implementation of (b') functionality are technically overlapped with those of telecommunication business (See Fig. 2). And the particular interesting possibility of converting "overlap" to "integrate" exists in service end-user connection subsystem of Fig. 1.

The separation/combination of the above (a') and (b') in terms of business operation unit making has many alternatives and is regulated differently in different countries. This is a good item of global coordination and alignment in the future.

(3) Other correspondence/comparison of various services

The current interrelationship between telecommunication and broadcast, which are described "naturally" in the above, can be compared with the interrelationship between mail (post)/transportation & delivery service and journalism of paper media type (See two box expressions of double-solid line in Fig. 2). Electronic publishing business of electronic memory package type is also interrelated to mail/transportation & delivery service similarly.

Another correspondence item is seen between (a') broadcast program edition of Broadcast Service Business and the offered information processing/storage portion included in Remote Access Information Service Providing Business (See a dotted-lined box expression in Fig. 2). The presentation of broadcast program center as a kind of information service centers, in Fig. 1 does reflect this natural correspondence.

2.2 Positioning of Motion-Picture-Oriented Services in Another Map of "Transfer Function Features versus Human Interface Media Varieties

Four motion-picture oriented services are mapped in Fig. 3, or another map expression, in which the horizontal axis aligns the feature varieties of information transfer of pure space-wise type as well as of time-wise transfer combined type (Ref. 4). This feature varieties is based upon/modified from B-ISDN Service classification of the CCITT. The vertical axis of Fig. 3 aligns the electronic media form varie-

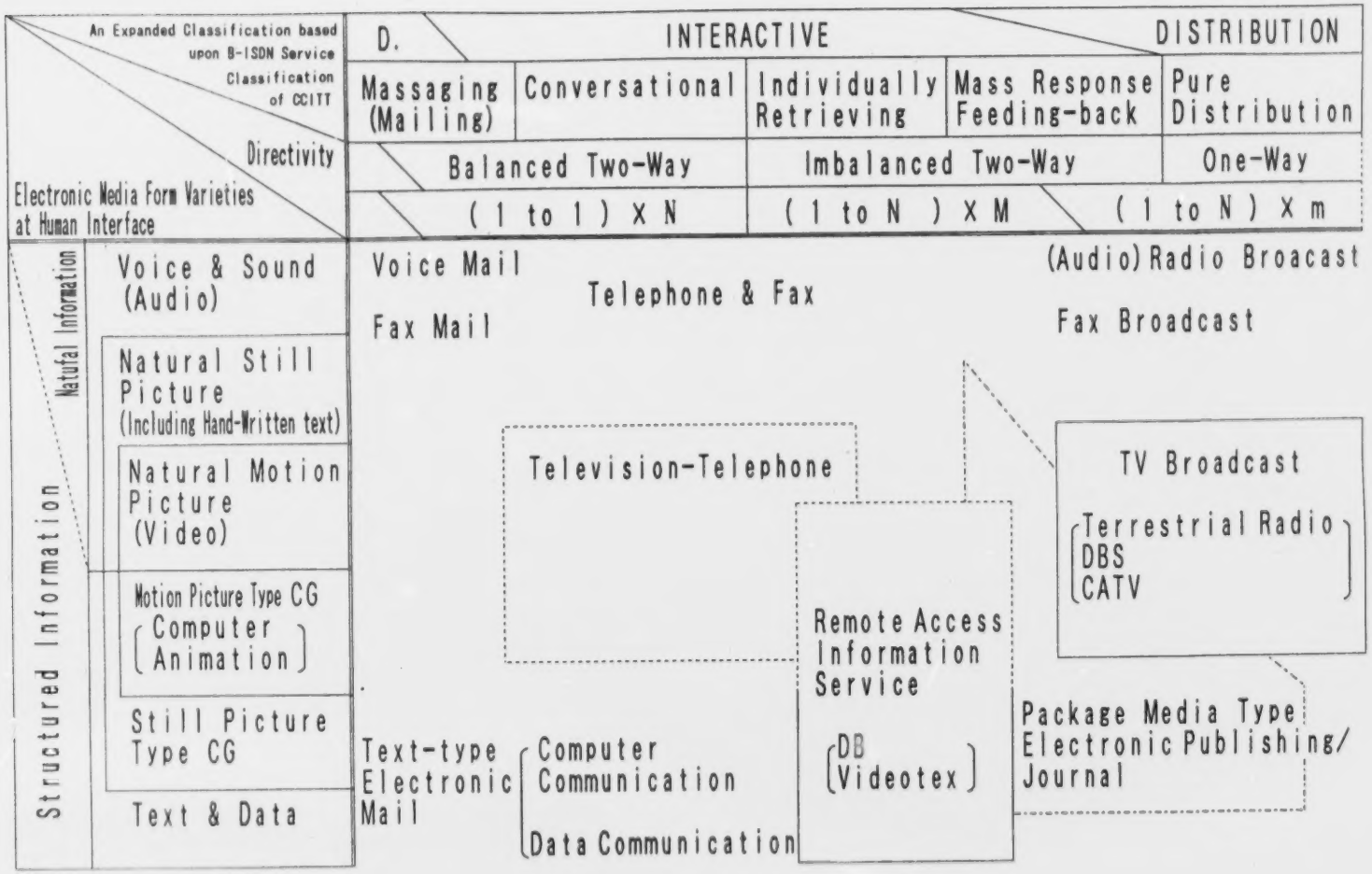


Fig. 3 Positioning of Motion-Picture-Oriented Information Handling Services

ties at human interface of information system/terminal (Refs. 4 and 5), where motion pictures of natural image type and CG type are centered purposely.

Identified four motion-picture-oriented services, which are expressed in "enclosure", are as follows:

(i) TV broadcast
(ii) Package Media Type Electronic Publishing/Journal
(iii) Remote Access Information Provision Service (of futuristic hyper-media type)
(iv) (Futuristic) Television Telephone.

The solid line portion of the "enclosure" represents the reality of the enclosed service, the chained line does the non-electronic transfer, and the broken line portion does the futuristic possibility.

In the map, non-motion-picture-type conventional transfer services are also positioned without enclosure for reference and comparison (Ref. 4).

The detail of discussion on this Figure 3 will be the subject of another future report. But here attentions are drawn only to the prediction that not only the above (i) and (iv), but also (iii) as well as (ii) seem to be important driving factors to promote the motion-picture-type usage of information infrastructure.

3. Legal Infrastructure relevant to Information Handling Services

3.1 Brief Review of Current Telecommunication/Broadcast-relevant Regulations (centering on Japan's case)

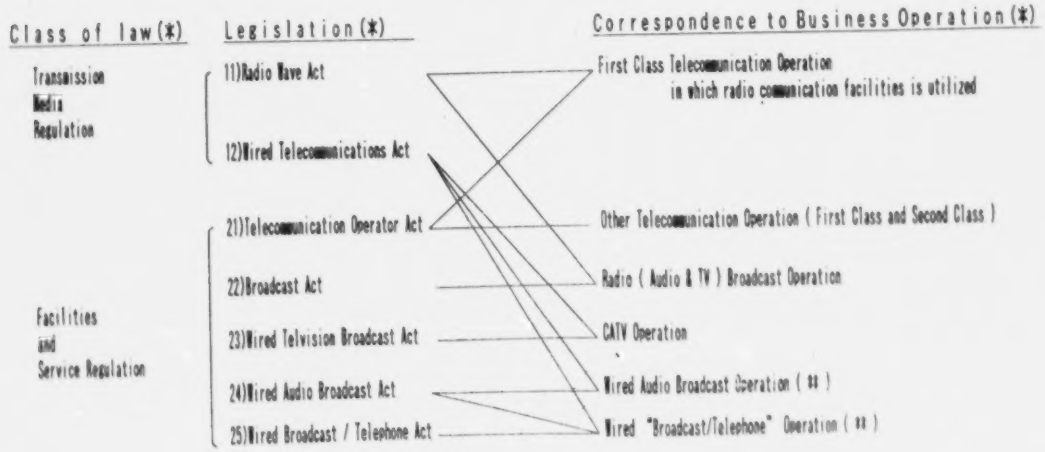
Table 3 indicates the relation of current Telecommunications/Broadcast-relevant Legislation and Business Operation in Japan as an example.

Two acts for transmission media regulation and five acts for facilities/service regulation are applied in various combination to telecommunication operations, radio broadcast operation, CATV operation, etc. Every legal infrastructure including this, reflects of course historical procedure of wired communication, radio communication and broadcast in each country (e.g. Ref. 6).

In the above Japanese legislation system, the following situations are identified as being noteworthy:

i) Radio (tele-)communication, which is the important one of several radio wave applications, and wired telecommunication are specified in fully separated way, in terms of transmission media. (Actually integrated use of transmission media in a system is commonly applied.)

Table 3. Current Japanese Legislation for Telecommunications and Broadcast


Class of law(*)
Legislation(*)
Correspondence to Business Operation(*)
Transmission Media Regulation
Facilities and Service Regulation
11)Radio Wave Act
12)Wired Telecommunications Act
21)Telecommunication Operator Act
22)Broadcast Act
23)Wired Telvision Broadcast Act
24)Wired Audio Broadcast Act
25)Wired Broadcast / Telephone Act
First Class Telecommunication Operation in which radio communication facilities is utilized
Other Telecommunication Operation (First Class and Second Class)
Radio (Audio & TV) Broadcast Operation
CATV Operation
Wired Audio Broadcast Operation (**)
Wired "Broadcast/Telephone" Operation (**)

(*) : English expressions here are arbitrarily translated ones (been not neccessarily authorized).

(**) : Those business operations are not significant in terms of business scale.

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ii) The technical and business operational possibility of the separation of broadcast program distribution and broadcast program edition is treated rather as an exception.

iii) Specifications on information transfer function for radio and cable-based broadcast operation are separated as exception in Telecommunication Operation Act and rather described on the side of Broadcast Act, Wired Television Act, etc. However, CATV Operation, which is specified as a kind of broadcast operation, is also regulated by Wired Telecommunications Act due to the use of wired transmission channel.

iv) The regulation of CATV conforms to that of radio broadcast in parallel, even though the major basis for radio broadcast operation is primarily the scarcity value of radio wave spectrum in the open space.

In correspondence with the above iv), it is said that other distinct bases of broadcast operation regulation in general can be (a) the discipline of anti-monopoly/oligopoly and (b) the concern on excessive social influence of mass media (especially electronic mass media). Those points seem to be applied, carefully depending upon the service characteristics, the size of business and/or the character of transmission.

3.2 Possible Unified Legal Infrastructure Composition for Electronic Information Transfer

Referring to Sec.1 (Fig. 1) and Sec.2 (Fig. 2 and 3), suggested is the possibility of unified legal infrastructure for electronic information transfer (electrical communication), as follows:

i) To be established first is the fundamental legislation which specifies the general framework of electronic information communication networks infrastructure (Fig. 1).
This infrastructure covers the both of conventional telecommunications and broadcast systems of all kinds:
(a) Simple or serially/parallelly integrated use of wired/radio transmission media,
(b) Various directivity (balanced two-way, imbalanced two-way and one-way) (See Fig. 3),
(c) Combination of connection ((1 to 1)X N, (1 to middle large M)X M, (1 to very large N)X M) (See Fig. 3),
and
(d) Electronic media form varieties at human interface (See Fig. 3).

ii) To be established in parallel is the fundamental legislation to specify the general characteristic of various information service systems.
They include broadcast program production centers and other service centers of electronic information processing/storage function use (See Fig. 1).

iii) To be positioned under the umbrellas of the above i) and ii) are regulation acts for individual electronic information business such as telecommunications operation businesses and broadcast operations businesses of various kinds (See Fig. 2).

In connection with the above i), the establishment of this legislation might be effective to ease the coordination of radio wave usage between radio broadcast and mobile/personal communication.

Further, in connection with the above i), radio wave (i.e. open space electromagnetic wave) application is not limited to information transfer (communication) in a broad sense. The regulation to other application could be an item of separate act or an independent portion of this fundamental legislation.

In connection with the above ii), Remote Access Information Service Business featured by imbalanced two way mode between information service providing centers and multiple number of end users on individual basis ((1 to N)X M), could be categorized as the third type of mass media business (Figs. 2 and 3) which is discriminated from paper-media type mass media business and broadcast business of radio/wired distribution types.

In connection with the combination of the above i) and ii), perhaps the far futuristic target of study could be the establishment of a "super-" unified fundamental legislation covering all kinds of information handling service business, referring to Figs. 2 and 3. This legislation would possibly cover all electronic information services businesses in a broad sense, including the businesses of telecommunication service (network operator service, communication carrier service) and broadcast and "narrow-"cast businesses covering the both functional aspects discussed in the above (a') and (b') in paragraph (2) of Sec. 2.1. This study might touch upon the "flexible" borderline between electronic media and conventional paper media (Fig. 3) eventually.

3.3 Possibilities of Common Deployment and Operation of "Local & Public Information Alley"

It is further suggested to study the idea of possible legal support to carry out commonly the installation, operation & maintenance of service (end-) user connection system (c.f. Fig. 1 and Tables 1 & 2), by a new kind of organization such as public organizations or independent business firms like so-called the zero-th class network operators (Refs.7 and 8). They are to be separated from conventional organizations such as local telephone operators and CATV operators. Those conventional organizations could continue to be responsible to interactive services like television telephone, and to distribution services like television broadcast, respectively (Refs. 9 and 4) in the era of B-ISDN. In the era, FTTH/P/C type service end-user connection system, which could be called as "local and public information alley", would be possibly deployed by the above proposed new kind of organizations.

4. Concluding Remarks

Service users at home and working place will expect appropriate joint services of the both of television broadcast (distribution) type and audio-visual (interactive) telecommunication type. It is expected that this report, attached with study proposals, will be of some use as a stepping stone to the future optimization study of relevant legal infrastructure and facilities infrastructure in this field of overall information handling service businesses.

Acknowledgement

This report is based upon a study activity carried out by the Working Group-B (in August 1990 - March 1991) of Information Communications Service (ICS) Study Committee of the Institute of Electronics, Information and Communication Engineers (IEICE) of Japan (Refs. 10 and 11).

Authors express their heartfelt appreciations to other WG participants (alpherbetical order): Messrs. Kazuyuki Aoki (MPT), Katsuhiko Furuya (Tokyo Electric Power) and Ko-ichi Takeuchi (NTT); Dr. Youzo Utsumi (NHK); Messrs. Hajime Yamada (Oki Electric Ind.) and Kunihiro Yamada (Ricoh), for their cooperations, contributions and discussions. Authors are also thankful to the kind encouragement and thoughtful guidance of the following ICS Study Committee officers: Dr. Ken-ichi Tsukada (Former Chairman, Matsushita Electric (Panasonic), Prof. Sho-ichiro Asano (Current Chairman, National Center for Science Information Systems) and Dr. Yoichi Sakai (Secretary, NTT).

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INTRODUCING FIBER OPTICS INTO THE NEW TOWNS OF THE 21ST CENTURY

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Fiber optic networks and the availability of broadband capabilities will lead the information services industry into the 21st century. "New Town", mixed use, developments provide the economic and service base necessary for these networks to emerge in the mass market. New Towns provide the forum for telephony, video and information services to co-exist.

As I open my remarks it is important to recognize a number of factors. Primarily these are that anyone associated with the telecommunications and information services industry feels an almost overwhelming call to address and plan for a broadband future in the 21st century. Each of these participants also wonders which applications and what standards will deliver profitability or perhaps better stated - acceptable returns on investment on this broadband infrastructure. The opportunities include video services delivered in higher definition and increased channel capacities to audiences in the American home.

The challenge is finding the market to deliver those services while recognizing the requirements to "redefine the telecommunications business". Although Fiber in the Loop (the entry forum for fiber networks) is driven by precise standards of technology, service, standards and applications, and we very appropriately debate cost and architecture (curb/home etc.), it can be argued that deploying FITL and "finding" the customer base is somewhere between a **challenge**, an **opportunity** and a **responsibility.**

Having had the opportunity to experience the development, cable industry and telephone perspective, there are some factors worth mentioning.

The phone company and the cable industry don't like each other; although they share a common ultimate goal. The development industry is a conservative, debt driven business that seeks a market edge but generally fails to agree on or recognize how to market advanced technologies in "New Towns" and Master Planned Communities.

Although telco and cable often publicly debate their respected positions, often these industries are faced with similar problems. For the cable industry, pay service revenues are down, new build opportunities are down, and money is "unavailable". For the phone company, the vision of broadband is coupled with the cloud of "who are the paying customers". Competition that never before existed is everywhere; long term profitability is in jeopardy.

The real estate development business is perhaps the most volatile of the three. Land values have changed dramatically, lending in the industry is elusive at best, and markets that were hot are cold and cold are hot. The need to define market stability and cost effective infrastructure is a major requirement.

Even with these important issues, it is unreasonable to expect cross industry cooperation and assertive strategic business decisions immediately. It is also unreasonable to anticipate telecommunications serving as a foundational element of a new town without appreciating outside influences such as regulatory, political and business risk. However, political pressure and solidarity in trade associations is one thing. Making money is another. If the economics of broadband works, "build it and they will come."

The first test for each of the three industries is always economic. It is interesting to note that we are hearing more and more about "investment-led economic recovery". Calls for a substantial increase in public infrastructure spending are heard everyday. Public investment could attack the backlog of rotting roads, bridges, subways, runways and environmental projects.

That in-turn, would create new jobs and markets for mostly domestic goods and services and STIMULATE NEW TECHNOLOGIES".

Others have called for tax and regulatory changes that would encourage utilities and telephone companies, to invest their money in modernization of the public network. Instead of allowing US Regulatory constraints to drive telcos to buy up telecom companies abroad, should there not be a renewed interest in investing in a state of the art optical-fiber grid for the U.S?

This optical fiber grid potentially provides the framework for the "intelligent communities" of the 21st century. A necessary definition here is "what is a new community of the 21st century. In the most recent decades, development has been linked to a particular place. There were residential communities separate from business parks; these were by their nature separate from industrial centers. In addition, certain regional locations, worldwide, defined what would work in which specified location. The business and commerce centers of the world is where business had to be. The tranquil mild climate residential regions is where we wanted to live. Today's world of instantaneous, interactive communications places technology at the desktop of any home or business. It brings world class competitive advantages to any location and considers for the first time a quality of life in concert with a quality of professional services.

My talk today will use the emerging New Town of Sutter Bay in the Sacramento Region of California as a case study. This 25,000 acre planned community places two disciplines at the forefront of planning and implementation; transportation and telecommunications. These, at one time diverse industries, are now definitions of each other. Transportation is telecommunications and fiber optic networks are the link between them. Establishing fiber networks in the new towns of the 21st century is a key element in the next century's success of the telephone, cable television and land development industries. The experience of Sutter Bay is a test tube microcosm of planning for these networks and their consumer acceptance.

In addition I will discuss the community of Heathrow in Central Florida, the first all digital ISDN community in America. Together these frame the essential elements to be considered in the deployment of fiber in new towns.

As reported in Business Week earlier this year, the ability to promote and provide fiber in the public network would require liberalizing both depreciation allowances and regulations that currently prohibit local operating phone companies from offering consumer services such as CATV and videotext.

Assuming that I recognize the audience of this conference, I can predict that telco interests here are in agreement with these philosophies. The realistic "other-side" of this discussion, the established CATV industry, has quite successfully attacked potential changes in depreciation allowances and regulations that could pave the "new road" of an optical-fiber grid. These changes, it has been stated might place an unfair advantage in the hands of the telcos perhaps speeding up the inevitable to pave the way for unfair competition, and drive the interests and influences that made the video delivery service what it is today out of the business. Although this can be seen as an American perspective, it shares strong similarities with efforts to create competition in the U.K., Australia and other international locations.

The arguments are real and relentless. Therefore a middle ground - a partnership attitude must be created before anyone wins and perhaps the national economy(s) loses. The interests of the cable industry have not generally been compatible with the interests of telcos. Although spirited competition has served as the hallmark and foundation of American business, the lack of co-operation between these two industries is sprinkled with regulation, litigation, misunderstanding, mistrust and simple lack of logic.

If we find the right cable operators, with the right property, and the fiber in the loop team presents a realistic outside plant alternative - the deals will materialize the path to strategic partnerships will be laid.

The introduction of broadband services in the late 80s and 90s, coupled with the emerging deployment of fiber in the loop portion of the public network has offered the potential of sophisticated services never before offered to the American home.

This introduction, although technically exciting, has however only begun to meet substantial market demand. Although broadband services will provide a wide range of advanced services, it is the delivery of video entertainment that could bring immediate return on investment. With this premise in hand, telco planning has centered on the expansion of fiber in the loop in new builds and in those communities where demographics and expectation of customer demand has been significant.

The President of Pacific Bell, Phil Quigley recently addressed this by questioning "How do you make sure you're amply prepared for anything, and yet over-prepared for nothing?.... It could cost about $900 billion to build the nationwide broadband digital network that most experts now agree this country will need. "

To achieve some form of competitive position, it is necessary to charge ahead in the construction of this network. This "charge" requires partners. Quigley mentioned that "government" is a potential partner (with some caveats) . In his definition of "partner" he describes one who shares the risk and the rewards of a venture. He reminded his audience however that it was the policy of our federal and state jurisdictions that the public will not be a party to the risks of network modernization. "Judge Greene says you can modernize all you like, however the RBOC just can't sell certain services that you'd build a modern network to deliver." The regulatory commissions are all for modernization - but not until you're sure the new capacity will be used immediately.

Whoever the partner might be, there are similar objectives and concerns are described by Quigley, that is "lest we never forget..... that it's other people's money, and they expect a return; " and in most cases a quarterly return. This is the case in the telephone, CATV and real estate development businesses.

To assume that any investment in bandwidth is a sure winner would be wrong. The right way is the hard way: A careful reckoning of the market direction, and an aggressive effort at **stimulating demand.** Video re,resents the most achievable and most "return rich" investment available in a Fiber in the Loop analysis. The typical American spends 61 hours a year on the telephone, but more than 2400 hours in front of the television: a broadband network can deliver both. Where should the natural interest" lie?

FIBER IN THE LOOP TRANSPORT SERVICES

Fiber in the Loop is not simply a technology or transport medium. It is pipeline to the future, the key component to profitability in the 90s and beyond. Although parity between copper and fiber construction has been elusive to date, indications are that the cross over point will be achieved in the early 1990s. Therefore American telcos can look optimistically to cost effective Fiber in the Loop and a ready customer base: or can they?

Fiber In The Local Loop joint opportunities are at best illusive and more realistically unreachable at this time. The reality is that the best design, the best technology, the best construction is today faced with the accepting that telcos and the traditional market leaders in video delivery, CATV operators, don't recognize the need for working together, and the mutual benefits potentially available to each other. In addition, the essential other element, the real estate and the motivated real estate developer is often not included in the strategic planning.

The reasons for the failure to capitalize on the opportunity are many. In relation to the telco/catv issues the reason is perhaps as simple as two competing industries failing to find common ground.

These two industries believe today, more strongly than ever before, that there is no middle ground between telco interests and CATV industry interests. As the battle is waged in the courts and legislative arenas around the country, the potential loser is not even a participant. That loser, the American consumer, is simply a byproduct of the action.

To analyze this includes operational, fiscal and legal issues that have both set the stage for the battle as well as establish the opportunities for a "partnership". The Consent Decree has established specific "albeit current" guidelines which define and limit the role of the RBOCS. To assume an environment inconsistent with these regulations would be to envision a joint opportunity that might never exist. In this regard, today's paper assumes that fiber in the loop services should be offered in a regulated transport arena with key and specific limitations.

Although the more entrepreneurial interests of a Regional Bell Operating Company in the US might conjure up higher and more attractive revenue scenarios, through programming and content control, it is impossible to establish and "sell" a partnership without strictly and specifically defining the respective roles of each partner. Clearly, the CATV industry sees the telco, made up of regulated and non-regulated companies, as a giant with many arms and legs; unable to shed or separate its regulatory limits from its entrepreneurial ventures.

This paper does not describe in detail the non-regulated new business ventures of a telco, rather it presupposes that "Joint Opportunities in FIBER IN THE LOOP" are predicated on opportunities between cable operators and regulated transport companies.

Therefore the joint opportunity today should be the telco providing broadband transport and the CATV operator providing content, marketing, programming and customer service. The then final link is the New Town development providing the real estate, the opportunity for new, not retrofitted infrastructure and the joint marketing.

Basically speaking a joint opportunity takes advantage of parties each doing what they do best. In this case, the above split very precisely uses the strengths of each organization.

Questions that must be routinely asked and debated are "who should the RBOC do business with? This is especially true as it becomes increasingly apparent that no amount of capital can effectively rebuild the urban cores of America. Try as you might to capture the revenue potential of downtown Los Angeles, Chicago or Miami, the reality of costs (both product as well as labor) is that in the near future it will be prohibitive to retrofit.

Even if retrofit were not the choice, the DS3 highway system resident in American RBOC architecture was never constructed to accommodate broadband video service. Therefore, the decision to pursue and "sell" video transport on a "public network" is burdened by the requirement for expensive equipment such as video codex(s) and other expensive add ons not generally required in a dedicated video transport architecture. This might and often causes telco prices to exceed market rates. In addition, these non-tariffed services generally require customer pricing that is not subject to "average tariff" costs and often places the total price burden on facilities that might perhaps be used in later service offerings. As much as an RBOC might wish to advertise the availability of video transport services, they realistically do not have the refined merchandise to give to even the most willing buyer.

Should the RBOC do business with the developer of "New Towns" throughout America? These New Towns have the ability to not only build large scale communities, but to plan for the deployment of infrastructure and the required usage of services through deed restrictive covenants. This presents an attractive feature offering for broadband services. In addition, many developers of large scale "New Towns" are in fact the service providers for video (i.e. the cable operator), again bringing more centralized revenue potential.

Doing business with either a cable operator or a developer is both the only logical path but also the path laid out with the most potential for problems. This is primarily the case because both of these industries do business very differently than the way RBOCs are traditionally educated to pursue opportunities.

Cable and development are debt driven businesses. In most cases, CATV operators and developers have little fluid capital. Although recent clampdowns on lending have curbed the wild financing options of the 80s, it is very difficult to find net worth on a balance sheet of the developer or CATV operator, their networth is primarily the value when they sell. In this cases RBOCs analyses will generally unveil what they define as "a house of cards". This discovery leads the telco into feeling that they are taking all the risk and allowing developers and CATV operators entre into a business - capital investment free; a factor that single handedly hurts most if not all deals open to telco transport.

This issue is answered by the cable operator by the fears of "common carrier", and the potential "balance sheet" loss of the hard asset "the wire". Although value is based on cash flow multiples, common carrier wire could de-value or no-value existing balance sheet assets enjoyed by the existing CATV industry. This issue cannot be ignored and must be evaluated and addressed by those purporting to promote common carrier transport.

This presentation in its detailed overview of Sutter Bay and Heathrow, will explain the environment of common carrier fiber and its impact on the telephone as well as cable operator.

LEGAL AND REGULATORY CONCERNS

Regardless of the business and fiscal desire of a specific telco to introduce FIBER IN THE LOOP and attract network transport customers, there are essential and imposing legal/regulatory hurdles that must be addressed by both telco as well as CATV operator.

In an environment sprinkled in proprietary "mistrust", these hurdles appear to enhance the revenue stream of the transport provider (telco), while limiting the options and profitability of the content provider (CATV operator).

The Communications Act of 1934 (as amended), Section 214, clearly outlines the policies and limits on Extension of Lines; these provisions have remained virtually untouched over the past 50+ years. The language of the Act and its approach to network services might appear routine and non-threatening to telco managers; in comparison is conjures up, to the CATV operator, concerns such as crossing enemy lines with no defense. Why?

Cable Television has thrived in past years as a non-regulated monopoly. This monopoly is defined in the most simplistic of terms, "I own the wire". The CATV industry, faced with high construction costs, with service acceptance at 59% of homes passed, has rarely overbuilt neighboring incumbents. He with the wire controls the neighborhood. Even the most ambitious operator, led to the negotiating table to examine telco transport opportunities, is scared off with the prospect of throwing their business plan open to the scrutiny, review and regulation of the FCC. In addition to the simple overview and regulatory scrutiny, "common carrier" reminds the CATV operator that poor marketing could more easily pave the way to competition; a feared if not paranoic concern. Although it can be argued that "the wire" is the least significant reason a customer might elect to subscribe to cable service, telco transport requires a journey into unchartered waters; a journey all too often left unexplored. The key reasons are really quite simple:

Access: A competitor could demand access to common carrier facilities without the typical investment. After all, service, the only real protection of one's investment has not been a hallmark of the industry.

Timing: An FCC 214 permit can take anywhere from 8 months to 3 years to process.

Three years is often the length of time a cable operator would take to construct, market and then re-sell an entire system.

Scrutiny: A 214 is a public review process. A 214 is a "telco" permit; what sane and aligned CATV operator would enter into such an Agreement? A 214 announces "common carrier" services. A 214 is a lightening rod for public intervention into a private business. A 214, although required, is more of problem than a solution.

THE FINANCIAL COMMUNITY

At $15-$18,000 per mile, building a coaxial or fiber CATV plant is an expensive proposition. This base cost, coupled with inherent difficulties in financing such costs makes cable an expensive business. That expense is however justified in that it stakes out one's territory; it is in fact geographic ownership. In addition, that capitalized investment is a balance sheet investment that is often used in the refinancing and plant extension arrangements that build toward long term profitability. Although the actual plant is void of any relationship between customer service and programming quality, it is in fact a basis for a CATV operator's existence. To this end telco transport, irrespective of its quality and minimal entry fee to the operator, is a questionable commodity that must be explored, defined and justified prior to mass market acceptance as anticipated by telco planners.

In addition to these substantive issues, the cable system resale market as defined by the brokerage community remains a question that must also be addressed. A cable system will often sell every 5-7 years. The sales price, although often defined as a specified cash flow multiple, is computed assuming ownership of plant and plant quality. The resale value of a cable system with no proprietary plant is certainly suspect.

THE LONG TERM TELCO INVESTMENT

Every RBOC currently envisions itself as a long term participant in the video delivery business. Although it is impossible to predict regulatory and legal changes that might allow entry, certain key decisions today could provide a logical path forward regarding new business opportunities into the 21st century. The eventual entry of telcos into the CATV industry might in fact encourage current FIBER IN THE LOOP transport opportunities rather than deter them. The working knowledge of a partnership with the CATV industry might provide valuable long term market experience for both sides. The business of doing business, such as customer service and marketing strategy can be learned in the short term through joint agreements that achieve high returns for both industries; TRUST - FINDING THE RIGHT PARTNER THE KEY.

CONCLUSION

A CHALLENGE, AN OPPORTUNITY AND A RESPONSIBILITY. As addressed in my opening remarks there might very well be a split between these three (3) elements as we investigate the future of broadband services and public network FIBER IN THE LOOP.

Great opportunities in American business often fail to reach their intended and projected objectives. FIBER IN THE LOOP brings broadband technology to the doorstep of the 21st century American home. This talk has tried to build around the very specific objective of insuring a successful future for FIBER IN THE LOOP to both the CATV as well as telco industry.

In addition, it recognizes that the New Towns of the 21st century hold the key to successful implementation. This successful future is tied to a number of very precise and identifiable issues. If broadband fiber is a strategic asset to the telco, then its installation must be aggressively pursued regardless of "break-even customers" being immediately available. This might require shareholder investments to a degree not generally considered. To the cable operator this means that assets and value must be redefined. This redefinition recognizes that the outside plant is not the strategic asset.

To the real estate development industry it is again a redefinition. It is a redefinition of how we build our homes, offices, streets and transportation systems. It captures a strategic market factor and provides the opportunity to "build it in our homes of the 21st century". It recognizes that our children will live and communicate very differently than we do today. It identifies trends in land use and commercial growth and captures information services into the mainstream of our daily and social lives.

This redefinition on the parts of all participants represents the recognition that a competitive era is upon us. We must recognize that answering the call of competition is more of a concern to American business than the potentially selfish issues of "telco versus cable"- the time to come together in a spirit of partnership and co-operation is upon us.

The questions remain, however as to the proper motivation and perspective necessary to ensure that there is a broadband future in front of the service providers that addresses the combined voice, data and video needs of the American consumer. The consumers of the 21st century need your willingness, your desire and your ability to reduce if not eliminate barriers that will bring us the keys to the front doors of the American home - the keys to the revenues and services needed to achieve mass market penetration and mass market acceptance of these services.

The Cable industry is waiting. They are waiting because they have the same economic and revenue problems the phone company has. Those visionary enough to desire advanced services in a "composite information age" will look to the phone company. The development industry is waiting to understand what is going on and how they can adapt to a changing marketplace. The tide is turning; as indicated in recent regulatory changes.

It takes time and a dedicated effort toward finding the right customer at the right time at the right price. If that is accomplished, the partnership opportunities for broadband and information services in the new towns of the 21st century will be viewed as a resounding success.

The Commercialization Of Space

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Abstract

This paper will examine what the business of satellite really is. After 20 years in the business, Telesat has learned that the business is not satellite transmission, but, rather, entertainment, information, and education services. But before this business can work in any domestic environment, there are three fundamental issues which must be understood. The first is that there is no business known as satellite communications; the business is applications, and satellite technology is only a part of a truly effective communications network. The second point to be considered is that the competition for satellite is not the terrestrial transmission networks--it's not fibre. The competition for satellite is found at the application service level. Finally, every satellite company must deal with the issue of regulation. If that company is to survive it must be allowed to earn money, so regulating the technology is no longer the answer because it makes a satellite system less viable than a terrestrial system. In order for satellite companies to operate on a "level playing field" regulation must shift from the technology to the application.

For more than 20 years now Telesat has been developing and operating Canada's domestic satellite service. Telesat ushered in the age of satellite communications when it launched its first Anik satellite in 1972. And earlier this year we launched the largest and most powerful domestic communications satellites ever put into space. That history has made Telesat the world's most experienced domestic satellite company, and its employees have earned an international reputation for engineering expertise.

Since 1985, Telesat has offered a growing portfolio of high-quality voice, data, image and video services that offer Canadian businesses the competitive edge that is so important in today's expanding global marketplace. Those services and others currently in development have transformed Telesat from a transmission service provider to an applications service provider, an experience which has given the company a unique perspective on the satellite communications industry.

Throughout its years of operations, Telesat has never had a loss year, but it has had very few years of reasonable earnings, or of earnings comparable to those routinely achieved by its terrestrial competitors. We believe this experience is not very different from that of other satellite carriers. Very few of the satellite operators around the world who publish financial results have ever been able to achieve adequate earnings for commercial operations.

This being the case, Telesat has often grappled with the issue of what the business of satellite telecommunications really is. After 20 years of launching and managing Canada's domestic satellites, and commercializing Canada's space, Telesat has learned that the business is not simply satellite transmission services, it's telecommunications applications.

We have also learned that isolating the satellite technology from the terminal and telecommunications access technology from the networks is incompatible with business success for the satellite operator. Although some regulatory environments insist on this scenario, the fact remains that a satellite operator must have access to telecommunications traffic on an equal footing with its terrestrial competitors if it is to be commercially viable.

In order to understand this, and in order for the satellite business to work in any domestic environment, there are three fundamental issues which must be understood. The first is that if there is no business known as satellite communications, and the business is really telecommunications applications, then satellite technology is only part of a truly effective communications network. The second point to be considered is that the competition for satellite is not the terrestrial transmission networks. It's not fibre. The competition for satellite is found at the application service level. Finally, every satellite company must deal with the issue of regulation. If a satellite company is to survive it must be allowed to earn money, so regulating the technology is no longer the answer because under that type of regulatory structure a satellite system is less viable than a terrestrial system.

Only by dealing with these issues can a satellite company become successful, and only by dealing with these issues can a satellite system be truly commercialized

The Business Of Satellite

When Telesat first entered the business the idea persisted that the role of satellite in communications was as a bulk communications transmission provider, or carrier. Telesat is now in its third decade of operation as a satellite communications provider, but until a little over five years ago our market was limited to other telecommunications service providers. We were essentially a carrier's carrier, a wholesale provider of bulk telecommunications capacity to other carriers, such as Telecom Canada and Unitel, formerly CNCP. During that period, Telesat depended completely on other carriers to develop and market end-to-end satellite-based communications services which would generate revenues. But although the carriers were willing to use satellite services themselves, they did not promote satellite private network applications for what they saw as a competing technology.

This all changed in 1983 when Telesat took the initiative and began to take its own services to the market. We obtained the right and began offering retail level services to TV broadcasters. In 1985 we gained the right to take the next step, and began developing and marketing business communications services directly to corporate customers. Since that time, we have been providing both broadcasters and businesses with a versatile, reliable, alternative source of communications services.

Our marketing efforts have met with considerable success and today we are the carrier of choice for the broadcast industry. Nearly everything Canadians watch on television is transmitted via our satellites, and every TV network in Canada has switched from terrestrial networks to Telesat's satellite distribution services. That's how most Canadian businesses have known us for some time. But we have also developed reliable, high'-quality, end-to-end communications services to meet the needs of the business community, and many Canadian organizations have already opted for the satellite solution.

One of those customers is Canada's national newspaper, The Globe and Mail. For more than ten years that publication has been using satellite to transmit its national edition to major cities across Canada. Other organizations have also discovered the satellite option. Banque Nationale, Hudson's Bay, Canadian Tire, Gandalf, and the Atmospheric Environment Service are only a few.

What we've learned from all this is that a truly commercial satellite system offers the flexibility, cost-efficiency, and consistency not available from other systems. That's because the very nature of satellite communications makes this possible.

A satellite network offers flexibility because of the relative simplicity of a satellite communications system. Satellite links can be established virtually anywhere quickly and with a minimum of effort, and locations can be added, moved, or upgraded as needs change. A satellite system is flexible enough to allow existing terrestrial locations and equipment to be integrated with a satellite network.

In terms of cost, satellite service is generally more cost-efficient than its terrestrial competition. Advances in technology have brought down the size and cost of satellite earth stations so that satellite communications is now an option for all companies. And with the advent of teleports, earth station costs can be spread among several customers, making satellite communications more economically attractive than the terrestrial counterparts. Also, private satellite networks are inherently more efficient than other networks because a single satellite channel can accommodate voice, data, or video communications between any combination of sites within a network. Finally, satellite communications offers further cost advantages because communications costs are based on distance insensitive prices. In a satellite network it would cost no more to send a data file between two cities in the same time zone than it would to send the same file between two cities in different time zones.

But the inherent flexibility and cost efficiency of satellite communications does not mean that the consistency of service is compromised. The very nature of satellite ensures that each site in a network, no matter how remote, receives the same consistent, high quality digital signal, because it goes up to the satellite from the transmission point and can be sent immediately to any number of sites across the country. And because of the inherent simplicity of a satellite network, there is less that can go wrong.

So what we've learned from our customers over the years is that the business of satellite is not simply bulk transmission services, but rather the business of satellite is entertainment, information and education services. Truly successful commercial satellite operators are not and should not be restricted to operating solely as transmission providers. Truly successful commercial satellite operators offer a unique and flexible communications medium which can be adapted to deliver entertainment to the home, data information to the office, or distance training and learning services to any location within a satellite footprint.

Three Issues To Be Understood

In order for a commercial satellite business to work in any domestic environment, there are three fundamental issues which must be understood.

The first is that if the real business of a commercialized satellite system is applications and services, then satellite technology is only part of a truly effective communications network. The financial or commercial failure of most new satellite companies has been the result of not having recognized this. Telesat has tackled this issue by creating a teleport infrastructure.

Teleports are shared-user facilities, where a number of users share the costs of establishing satellite earth stations. Over the past few years teleports have become important communication centers in major cities around the world. Since the first true teleport opened in New York city in the early 1980s, more than 70 international teleports have been established, and by the time Canada opened its first teleport in 1987 there were already 56 teleports in North America alone.

As Canada's national satellite communications company, Telesat has kept Canada at the forefront of teleport development since it opened its first facility in Toronto. Today, Telesat has five teleports operating in major cities across Canada, with a seventh in development on the west coast, and plans well underway for the expansion of its original Toronto site. Now, under a new agreement with AT&T in the U.S., Telesat will soon provide Canadian customers with access to a new teleport in Milwaukee, Wisconsin.

To date, Telesat has invested more than $20 million in telecommunications equipment for the Toronto teleport, and design plans have been finalized for a $15 million expansion to the original facility. Telesat's philosophy in planning the expansion, and in developing a Canadian teleport network, has been to provide environments where different businesses in the same field can find a certain synergy by working under one roof. Perhaps the best example of how that philosophy works is Téléport de Montréal.

Opened in 1987, the four-storey, 160,000 sq. ft Téléport de Montréal was developed in downtown Montreal with an investment in telecommunications equipment of more than $14 million. Today, the complex houses a mix of radio, television and data producers who make use of each other's services and expertise to conduct their business, and it is a unique consortium of successful engineering and commercial innovation.

There are three licensed broadcasters at the teleport: Météo Média, a weather channel, Le Réseau des Sports, a sports channel, and TV5, a French-language co-venture with Europe, all of which are major users of satellite services. The weather channel actually receives its weather data via satellite, packages it at the teleport, and transmits live, satellite-delivered, video programming 24-hours a day.

The synergy extends to other tenants involved in providing services to the broadcasting industry. LA SETTE does origination and transcoding; PMT Video provides studios and post production; and Pixart is a video producer. Telesat has located a sales office as well as its regional network services staff and a new Direct-to-Home satellite service at the teleport. SOGIC, a Quebec government agency which provides funding for film, video, and communications ventures, is another tenant. Finally, to accommodate very small businesses or start-up companies, an executive office center offers support resources such as reception, secretarial and conference rooms to 10 offices.

All these activities are supported by Telesat's technical center which provides 20 transmit services including no less than 13 full-time television uplinks. Telesat also provides numerous satellite receive services, radio services, and television scrambling services. The synergy at Téléport de Montréal was achieved through the cooperative efforts of the tenants, but it was made possible by the environment that was created at the site, and it is that same type of environment that Telesat has tried to cultivate at its sites in Edmonton, Calgary, Vancouver, and Toronto.

This is just one example of how a commercialized satellite system can work in the business environment. And it also shows that although satellite is the central communications tool, the technology is only part of an effective communications network.

The second point to be considered when developing a truly commercial satellite system is that the competition for satellite is not the terrestrial transmission networks; it's not fibre optic technology. The competition for satellite is found at the application service level, and that's where satellite companies should be concentrating their research and development efforts.

The reason for this is simple. As I noted above, we know that satellite communications offers some distinct advantages over terrestrial communications systems in terms of flexibility, cost, and consistency, but the fact of the matter is that all this is technology. Satellite companies promote the technological advantages of their systems and terrestrial companies counter that by promoting the technological advantages of their networks. It's a constant stream of propaganda that customers and potential customers have to wade through in order to get to what they really want to know. And what a customer really wants to know is what is the service you're offering me to solve my communications problem, and will it work?

In the final analysis a customer doesn't really care whether his information is distributed on terrestrial or satellite systems. What the customer really cares about is that his information is getting through at a reasonable cost, and in the most efficient manner available. Satellite VSAT services, therefore, are competing with terrestrial data services, and not with the fact that one is delivered over satellite and the other over fibre. The transmission medium and its network architecture only define the boundaries within which satellite applications can compete with terrestrial counterparts. So, in order for any company to be successful in the satellite arena it must first recognize that its applications services must be as good, if not better, than the comparable terrestrial application. This translates into high-quality, end-to-end satellite services which deliver value, flexibility, control and full service support. It also means that the satellite service provider must have a complete understanding of the customer's business, and the impact of the satellite service on that business in a technical and functional sense.

Finally, every satellite company developing a commercial satellite system must deal with the issue of regulation. If any commercial venture is to survive it must be allowed to earn money. Commercial satellite networks are no different, but in the current regulatory climate the ability to make money is hampered by regulation which is focused on the technology and not the business. If we agree that the business of satellite is communications applications, then regulating the technology is no longer the answer because it makes a satellite system less viable than a terrestrial system. In order for satellite companies to operate on a "level playing field" regulation must shift from the technology to the application. Competition will result and any commercial satellite company worth its salt will welcome competition.

At Telesat we strongly believe that competition is healthy and will only ensure that we continue to deliver the best value and service to our customers. We also believe that the very nature of commercial satellite systems will allow our application services to effectively compete with terrestrial service offerings.

From Telesat's perspective, this is what the business of a commercial satellite system really is. It is not simply bulk transmission services, but rather entertainment, information, and education services. Truly successful commercial satellite operators are not and should not be restricted to operating solely as transmission providers, since truly successful commercial satellite operators offer a unique and flexible communications medium which can be adapted to deliver entertainment to the home, data information to the office, or distance training and learning services to any location within a satellite footprint.

In order to understand that, and in order for the satellite business to work in any domestic environment, operators must understand that the business of satellite communications is really applications, and its true competition is found at the application service level. At the same time, regulators must understand that if that company is to survive it must be allowed to earn money.

Strategies For Market Entry By International Separate Systems

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2. **This paper will analyze the policy of the United States that supports limited satellite competition with the International Telecommunications Satellite Organization ("INTELSAT"). This policy initially met with substantial opposition on grounds that separate systems would creamskim dense routes, cause financial harm to INTELSAT and force lesser developed countries to incur higher service costs. The United States attempted to abate adverse consequences of its policy initiative by prohibiting separate system access to the Public Switched Telephone Network ("PSTN"), requiring long term contractual relations and articulating the expectation that separate systems would innovate rather than compete with INTELSAT for switched services. The paper will identify several types of separate systems with an eye toward assessing whether and how international satellite competition can enhance consumer welfare.**

3. Introduction

Most of the international telecommunications and trade policy initiatives in the United States and other nations result from interest in broader global market access, and the belief that enhanced domestic consumer welfare from deregulation can apply internationally. [1] However, international telecommunications and trade matters simply do not have symmetry with any one nation's domestic policies. Domestic deregulation does not necessarily jibe with the traditional PTT model, or any current liberalization initiative. Furthermore, the multilateral, cooperative nature of international telecommunications and trade policy militates against extrapolation from one nation's view. Accordingly, the pace of international liberalization may lack the speed United States deregulators and entrepreneurs would prefer.

This paper will examine initiatives to promote conditional international satellite competition with an eye toward predicting which types of satellite systems and strategies for market access will succeed. Satellite systems, separate from the INTELSAT and INMARSAT global cooperatives, have embraced different profiles and degrees of visibility as they devise methods to present users with a mix of service innovations and price cuts while avoiding legal and regulatory barriers to market access. At one extreme, an operating system has embraced a provocative, trendsetting posture that has achieved success, but perhaps only because the substantial weight of the United States Government was behind the initiative. Another system, with plans to located numerous satellites in the Pacific Rim, lacks governmental weight, but no shortage of ambition. At the other extreme, a number of systems deliberately seek a low profile in a high volume market. Midway lie regional market players and innovators who seek lucrative niche markets.

3.1 Governmental Philosophy Must Support Satellite Competition

In the United States, the FCC's mandate to serve the public interest increasingly points that agency toward deregulation. Other nations' public interest assessments evidence greater appreciation for a businesslike approach, and more likely consideration of non-government alternatives in narrowly defined, non-essential market niches. But no other nation, with the possible exception of New Zealand, currently believes that private enterprise can singularly make telecommunications facilities, services and equipment markets competitive and supportive of previously articulated social objectives.

Over the course of twenty-five years, the FCC has unbundled telecommunications equipment from service, [2] permitted tariff flexibility and reduced carriers' regulatory duties, [3] and shown increasing reluctance to impose structural requirements for guarding against anticompetitive practices. [4] It has dismantled a variety of regulatory policies that segmented the market into domestic/international, [5] voice/record, [6] satellite/cable, [7] dominant/non-dominant carrier,[8] and gateway/non-gateway factions. [9] But indigenous foreign markets may lack the size and potential for such reliance on open entry and competition. Many of the United States' policy initiatives, if embraced internationally, could result in stranded investment and wasteful duplication of facilities. For example, the United States domestic "open skies" policy [10] promoting market entry by private satellite operators would result in severe overcrowding of the geosynchronous orbital arc. The proliferation of satellites would threaten the ability of the International Telecommunications Union to resolve interference problems, and would support the claims of developing nations that developed countries are locking up too much of a limited and shared global resource.

The profusion of satellites does not necessarily guarantee that the market will absorb all additional transponder capacity without significant price cutting. Should the market not clear out all inventory, then questions exist whether an open skies policy promotes resource and technical efficiency, and whether society benefits from more satellite options that are sparsely loaded. One critic's view of international carrier collusion and anticompetitive practices, is another pundit's observation that international telecommunications policy requires collaboration even to the point of coordinated deployment and use of facilities and services.

Nations have begun to join the United States in supporting private alternatives to incumbent carriers' submarine cable consortia and satellite cooperatives. [11] But the general global view remains that competition between international cable and satellite transmission facilities--so called inter-modal competition--is not so robust as to support competing consortia or joint ventures, or a laissez-faire regulatory attitude toward how carriers should load such facilities with traffic.

The PTAT-1 cable in the North Atlantic[12] and the North Pacific Cable [13] demonstrate that transmission facility alternatives need not result in destructive competition, and price wars that might prevent carriers from providing essential, non-competitive services. Indeed, the very carriers that make up traditional submarine cable investment and operational consortia have acquired capacity in private cable alternatives realizing faster and cheaper circuit restoration options and some facility cost savings as well.

Cost savings, circuit redundancy and enhanced circuit restoration options notwithstanding, many nations refrain from supporting alternative carrier and transmission facility options. New United States carriers, which lack the common carrier status, do not have a regulatory agency's certification that foreign carriers expect. Such private carriers are perceived as lacking the proper bona fides, the commitment to long term service availability, circuit restoration options and reliability. Notwithstanding attractive prices, private carriers like Private Trans-Atlantic Telecommunications System, Inc. had difficulty in attracting carriers to end users until a certificated international carrier subsidiary of US Sprint acquired the company thereby conferring greater credibility and legitimacy.

4. International Satellite Competition

In 1984, a "Presidential Determination" [14] stated that international satellite systems, separate from the INTELSAT cooperative, "are required in the national interest." This one paragraph document set into motion an extensive policy making process and foreign relations campaign to establish a workable blend of procompetitive initiative and adequate safeguards for INTELSAT. On one hand, prevailing political and economic policies as applied to international telecommunications favor extending domestic procompetitive policies, like mandatory underpricing of some services, that have generated consumer and producer benefits. On the other hand, the international telecommunications marketplace involves pervasive government involvement including policies that have the effect of stifling private ventures and market entry.

The International Telecommunications Satellite Organization ("INTELSAT") represents how global cooperation has achieved ubiquitous satellite service at rates reflecting favorable economies of scale. The United States has executed a treaty-level document that requires a degree of forbearance from national satellite initiatives in favor of the cooperative approach. [15] Article XIV of the INTELSAT Agreement, requires Parties to the Agreement, i.e., governments and their Signatories who provide international services, to consult with INTELSAT prior to using or operating a separate satellite system to "ensure technical compatibility of such facilities . . . and to avoid significant economic harm to the global system of INTELSAT." [16]

Notwithstanding, its INTELSAT Agreement obligations, the United States government, through the Executive Branch and the FCC, implemented the Presidential Determination. In a joint "White Paper on New International Satellite Systems," [17] the Departments of Commerce and State articulated how United States international separate systems could operate without harming INTELSAT. The White Paper proposed criteria, which the FCC subsequently incorporated as conditions to licensure, [18] establishing limits on the scope of direct competition with INTELSAT.

The White Paper proposed that United States separate systems must:

1) not interconnect with the public switched telecommunications network in either the United States or any foreign locale;

2) establish long term contracts for the sale or lease of capacity; and

3) secure a foreign operating agreement and complete the INTELSAT consultation process before commencing service.

The FCC's 1985 decision implemented the Executive Branch's recommendations, and started the process for initial confrontation with, and subsequent accommodation by INTELSAT. After authorizing the Pan American Satellite System to provide international satellite service, [19] the FCC had to ensure that the sole United States Signatory to INTELSAT would fairly perform its task as emissary in the consultation process . The Communications Satellite Corporation ("Comsat"), incorporated by an Act of Congress, [20] must serve the public interest as articulated by the United States government, and pursue the best interests of its shareholders.

Prior to the onset of separate systems, Comsat enjoyed a de facto monopoly in international satellite service to and from the United States with the exception of domestic satellites, authorized to provide transborder services taking advantage of the fact that their footprints traverse nearby nations. Because Comsat must comply with official instructions of the United States Government when exercising its twenty-five percent ownership vote in INTELSAT, occasionally it must work against its business interest and that of its shareholders as occurred when instructed by the FCC, State Department and NTIA to push for the favorable consultation of separate systems. Comsat had to lobby its fellow Signatories to act in a manner which sanctions intra-modal competition, i.e., two types of satellite facility competitors. While most Signatories hedge their INTELSAT investment by participating in submarine cable ventures, such inter-modal competition has been deemed

acceptable. The concept of direct satellite competition, however, was difficult to accept.

The FCC licenses Comsat as a "Carrier's Carrier" in effect enabling it to serve as a middleman between INTELSAT and United States international service carriers. As a common carrier, subject to Title II and III of the Communications Act of 1934, in addition to the Communications Satellite Act of 1962, Comsat cannot discriminate or engage in unreasonable practices. Its sole Signatory status requires it to adhere to United States government issued instructions on how to vote and what to say on matters involving the public, as opposed to Comsat's private interest.

By favoring international separate systems, the United States government assumed the task of directing Comsat that its licensee and public interest obligations obligated it to advocate forcefully to the members of INTELSAT the need for a favorable separate system consultation. Prior to Pan American Satellite ("PanAmSat") the first United States separate system up for consultation, INTELSAT had favorably passed on a number of domestic transborder and regional systems. These include dozens of United States domestic satellites providing services to Canada, the Caribbean, Central America and parts of South America. [21] Additionally, INTELSAT had favorably consulted major regional systems operating in Europe, Southeast Asia, India, Brazil, the Middle East and elsewhere.

5. The INTELSAT Consultation Process

The INTELSAT Executive Organ, based in Washington, D.C., provides the cooperative with expert analysis on the extent of separate system technical interference and prospective traffic and revenue diversion. The Executive Organ staff advises the Board of Governors that serves as the cooperative's Board of Directors and is comprised of Signatory representatives from nations with the highest single investment interest and groups of Signatories whose collective investment share qualifies on quantitative or geographical diversity grounds. The Board of Governors then advises the Assembly of Parties that is comprised of government representatives from all nations associated with INTELSAT. The final document issued by the Assembly of Parties to the party proposing the consultation respects national sovereignty and is stylized as a recommendation. Nevertheless, the pursuit of separate system plans in the face of a negative recommendation would violate the spirit of the INTELSAT Agreement, and would likely result in no other nation conferring an operating agreement.

While INTELSAT was initially faced with as many as five large capacity United States separate systems, only PanAmSat and Columbia Communications, using capacity on two NASA tracking and data relay satellites, have become operational. Another separate system with significant financial backing, Orion Satellite Corporation, has received final FCC authorization and plans a satellite launch in 1993. [22] Still, the cooperative has legitimate concerns over its ability to provide ubiquitous satellite service at globally averaged rates. [23] Global averaging means that rates for high volume routes like the United States to Britain generally are priced the same as service on less dense routes like Nigeria to Thailand.

To safeguard its ability to average rates over a large global network and perhaps more parochial concerns about losing its near monopoly, INTELSAT uses a "worst case" analysis of technical and economic harm. This has meant that INTELSAT will attempt to safeguard non-existent, but possible future satellites from interference, through the use of technical criteria far more rigorous than typically used by the ITU's International Frequency Registration Board.

On the economic front, INTELSAT has vigorously objected to a separate system at the same time it alleges that robust traffic demand necessitates additional satellite capacity. Such a dichotomy called into question the legitimacy of the INTELSAT Executive Organ's analysis particularly because it appeared to assume that it would carry any traffic handled by a separate system. In effect, INTELSAT assumes one-for-one traffic diversion, thereby completely ignoring the possibility of market growth and demand stimulation by separate systems. It is quite possible that consumers' demand elasticities and risk tolerance profiles might limit the extent of direct competition between INTELSAT and separate systems. The latter might serve extremely price sensitive users who otherwise might use air couriers or less immediate delivery options in the absence of a one satellite carrier offering significant price reductions.

The INTELSAT Executive Organ's initial findings on PanAmSat, as it had been with other separate systems, pointed to peril and adverse impact. Many nations had expressly articulated their opposition to United States separate systems, despite the fact that they had participated in other separate satellite ventures and their international carriers regularly invested in trans-oceanic cables that in effect compete with INTELSAT and have no consultation obligation. PanAmSat and other United States separate systems threatened to exceed an unofficial 10% revenue diversion figure that serves as INTELSAT's threshold point for separate system economic harm. That figure represents a running total of all previously consulted separate systems, making it increasingly difficult for new systems to pass muster.

However, both PanAmSat and Orion Satellite have achieved favorable consultations with INTELSAT, and the cooperative recently streamlined the consultation process for systems of less than 30 transponders with less than 100 voice-grade circuits that access the public switched network. [24] While initial United States separate systems became the subject of vigorous lobbying by both Comsat and the United States government, as well as the politically savvy leadership in INTELSAT, recent consultations have become more perfunctory and less contentious.

Having itself waged a vicious informational campaign, including advocacy before the United States Congress, the INTELSAT leadership has grown to realize that the United States intends on seeing its separate system policy implemented, even in the face of a negative Assembly of Parties recommendation. INTELSAT was faced with the prospect of a confrontation, or the necessity of having to moderate its economic harm findings. On several prior occasions, INTELSAT has identified ways to avoid findings of economic harm, primarily by deeming INTELSAT not significantly impacted by the services provided by a particular separate system. In the case of United States-Canada transborder service, INTELSAT concluded that domestic satellites would augment existing terrestrial facilities. In the case of Eutelsat, a regional system with service throughout Europe, INTELSAT reduced its preliminary finding of 10% economic harm from that one system to a less than a 1% impact, on a new found recognition that Eutelsat would augment existing terrestrial options. Even where such terrestrial options were at best skimpy, and at worst non-existent, as was the case with Arabsat in the Middle East, INTELSAT displayed political wisdom in opting not to confront.

United States separate systems aiming to serve dense trans-oceanic routes present INTELSAT with a threat that cannot go unchallenged. There is a justifiable concern that a number of United States separate systems can skim the cream of profitable dense routing leaving INTELSAT as the carrier of last resort for less attractive routes, particularly to less developed nations. Even the prospective of such harm and proliferation of satellite options has the effect of presenting foreign policy and national security concerns. The prospect of INTELSAT retaliation through procurement of non-United States satellites and launch vehicles has made the separate system policy all the more risky.

On the other hand, the United States separate system restrictions have rendered fully 80% of INTELSAT services off limits. INTELSAT has been able retain a policy of averaging costs for switched services over all routes without fear of substantial traffic diversion. Separate systems have concentrated on customized, non-switched offerings like video that have experienced quite robust growth. Accordingly, the few United States separate systems, which actually enter the marketplace, can be considered niche players in no position to threaten INTELSAT, impair spectrum or orbital slot management, harm developing nations, threaten national security concerns or hinder the United States balance of trade. The potential for enhanced consumer welfare, service diversity, some downward rate pressure and innovation is too good to pass up merely on a quite unscientific, internal INTELSAT analysis.

6. Rethinking the United States Separate System Policy

Over the course of several years, many nations have associated with the INTELSAT consultations of United States separate systems. Rather than incur any semblance of economic harm, INTELSAT has experienced absolute capacity shortages in the North Atlantic region and has pursued programs to expedite deployment or lease of additional capacity. What was once characterized as a threat to INTELSAT's very survival has become a relatively insignificant matter, resolved in many instances by expedited and streamlined procedures to free the cooperative to attend to more pressing matters. INTELSAT now has become less preoccupied with separate system competition and more involved in the business at hand: arranging for more capacity and deploying it in ways that make it attractive to users with fiber optic cable options.

The fragile peace between INTELSAT and separate systems was challenged in 1991 with the proposal by PanAmSat that the FCC abandon the public switched telephone network access restriction. [25] The vast majority of commenters favored such abandonment, but the Commission initially chose to confer with the Executive Branch before unilaterally acting to change the separate system policy that resulted from inter-agency coordination. The lobbying campaigns and policy debates have returned, and new concerns about national security have been raised on the ability of the intelligence community to monitor all international switched traffic.

7. Types of Separate Systems

7.1 Provocateur/Trendsetter

The Provocateur/Trendsetter model involves a proactive system willing to challenge the status quo even at the risk of creating the perception that it is a threat to PTT revenues and incumbent satellite systems. For any nation's separate system policy to result in actual market entry, at least one satellite system applicant, typically the first or most entrepreneurial, must take an aggressive posture promising users new and cheaper service opportunities. In the domestic United States interexchange telephone market, MCI Telecommunications, Inc. fits the Provocateur/ Trendsetter model, and in the international satellite arena, the label belongs to Pan American Satellite, Inc.

The mere threat of competition forced incumbent carriers like INTELSAT and INMARSAT to embrace a more businesslike approach to service. But at least initially, it fostered a seige mentality that stimulated thinking on ways to thwart and delay market entry. The consultation requirements, International Frequency Registration Board coordination process and regulatory oversight became vehicles to frustrate the Provocateur/Trendsetter. These administrative delays, in conjunction with the fact that the system initially would involve only one in-orbit satellite, works to abate the advantage of early entry and the potential to capture a larger market share than latecomers. On the other hand, real or perceived opposition by incumbent satellite operators and the telephone companies, which must confer operating agreements to accept and hand off traffic, fuels the perception that the Provocateur/Trendsetter is an iconoclast and innovator who must overcome unfair obstacles to serving the public.

The Provocateur/Trendsetter will generate a lot of publicity in its search for a market. But such press coverage will have a mixed message. Depending on the sympathies of reporter and reader, the satellite system will provide the benefits of competition, or create trouble not worth the extra effort users and carriers might have to exert for the privilege to receive and offer service. This type of system appears to savor the battle for initial market access, and later for elimination of any impediment or service barrier, e.g., services that access the public switched telephone network.

7.2 Low Profiler

The Low Profiler model capitalizes on the market development efforts of Provocateur/Trendsetters while deploying additional "plain vanilla" capacity. Carriers of this sort like Columbia Communications, Orion and Unicom seek to ride the coattails of others with an eye toward capturing market share with less expense and travail. They enter the market later, after others have fought policy battles, and secure market share when the risk of PTT retaliation or non-cooperation has abated. What the Low Profiler loses in terms of an untapped market, it presumably gains in the ability to sell or lease capacity with few if any challenges to legitimacy.

Over time, the Low Profiler may have to sacrifice fewer markets and refrain from less "provocative" practices as the concept of separate systems becomes more palatable to PTTs. The Low Profiler can easily lease capacity to users when incumbents face a shortfall or lack the specific type of facility or service desired. And this type of separate system may provide services that access the public switched telephone network without the fallout previously encountered by earlier market entrants. On the other hand, when incumbents have ample capacity and fear lost market share, even the Low Profiler constitutes a competitive threat.

Irrespective of whether it will take away market share from incumbents, the Low Profiler may experience the same difficulties in securing operating agreements with PTTs as the Provocateur/Trendsetter. The marketplace prospects for newcomers are handicapped by consumer perception that it has nothing new to provide. The possibility of a less attractive orbital slot and look angle to the separate system satellite exacerbates this perception.

7.3 Innovator

The Innovator model concentrates on providing greater convenience, flexibility, customer service and access to the rest of the world. Prospective low earth orbiting satellite systems, which promise global or regional mobile telecommunication services via handheld terminals, represent the Innovator model. They primarily addresses consumer requirements rather than make strategic assessments on what profile to assume, and perhaps ignore some of the fundamental requirements like resolving questions on spectrum availability.

The Innovator seeks to provide new services to untapped markets, or to provide better service to underserved areas. Accordingly, it will emphasize the ability to generate new traffic rather than migrate traffic from existing carriers. To the extent the Innovator can serve a rich untapped market, it can exploit inelastic demand and charge supracompetitive rates. But it must predict which market is worth entry and be prepared to frontload substantial investment in the face of uncertainty in terms of consumer demand, spectrum allocations at World Administrative Radio Conferences and spectrum assignment/licensing by national regulatory agencies.

The Innovator expects to reap a hefty profit before other carriers match its innovations. That profit accrues only when the Innovator can attract the first rung of users, so called early adopters, willing to invest in a new terminal and other equipment needed to access the satellite. Where the Innovator proposes the use of a new frequency band, it raises spectrum allocation, regulatory, licensing and policy issues that can convert its status to Provocateur/Trendsetter in short order, particularly if its proposals are perceived as a threat to the status quo and incumbents' frequency assignments.

7.4 Regional Marketer/Niche Player

The Regional Marketer/Niche Player brings new or improved services to a specific region, often simply by employing a better satellite orbital position, beam or signal. Such a carrier can become the INTELSAT for the region or concentrate on market niches, e.g., video and VSATs. A regional market play requires close cooperation of investing national carriers and regulatory authorities. As such, it is more likely that the Regional Marketer/Niche Player will have secured regulatory approval well in advance of launch. Such authorization may come readily in view of the concrete benefits that accrue to the region and the absence of a financial threat to incumbent carriers.

While the Regional Marketer/Niche Player may encourage others to enter the market and provide some degree of price and service competition, the more likely outcome depends on the adequacy of demand, and the response of INTELSAT. In the case of Arabsat, internal management problems and unwillingness to stimulate demand by authorizing diverse video products lead to a less than stellar financial outcome. On the other hand, Palapa, the Indonesian satellite system, has thrived, because of that nation's dispersed island geography, the willingness of other nations in the ASEAN alliance to lease capacity for telecommunications and video service, and the disinclination or inability of INTELSAT to sponsor a region specific discount or improved spot and hemispheric beam to serve the region. AsiaSat has managed to harmonize investors from Hong Kong, China and the United Kingdom while convincing various governments in the region that diversified television options--"television without borders"--will enhance consumer welfare without threatening political stability. Its success may also result from superior signal strength and customer service, despite the higher transaction costs many multinational consumers incur in having to do business with more than one satellite carrier.

7.5 Opportunist/Extortionist

The Opportunist/Extortionist model exploits the International Telecommunications Union procedures on satellite orbital slot registration and the desire of developing nations to become a participant in the satellite delivered information age. The Opportunist simply seeks to capture some of the benefits in satellite technology for its citizens, even if this means cash or free transponders by providing a "flag of convenience" to a foreign satellite carrier. This designation might apply to Tonga's Tongasat and Papua New Guinea's Pacstar as outside entrepreneurs have provided guidance on how these nations might participate in the satellite sweepstakes.

The Extortionist goes several steps further and seeks to broker orbital slot registrations much like one might sell a New York City taxicab authorization or stock market membership. Tongasat registered a total of thirty-one satellites in twenty-six orbital slots before agreeing to narrow its Advance Publication requests with the ITU's International Frequency Registration Board to six. It allegedly sought to "sell" to INTELSAT and others its claim to one or more of these valuable orbital parking places. One can certainly see the intrinsic value in a bona fide orbital slot registration, but the process does not establish a property interest, nor is it contemplated that parties will buy and sell them.

The Opportunist/Extortionist suffers an identity crisis. Is it a legitimate player promising regional service where it is desperately needed? Or is it a front for a foreign entrepreneur seeking to provide a thick route service, or perhaps no service at all? While the possibility exists for better regional service, particularly for developing nations entitled to claim a fair portion of the shared geostationary orbital arc, it is just as likely that the Opportunist/Extortionist has nothing but a paper satellite to pitch. For the latter type of gambit, IFRB procedures will eliminate the registration in six years while INTELSAT and other incumbents have refrained from buying slots they normally can secure for nothing.

1. The FCC believes its procompetitive, open-entry policies will foster "an improved international communications system with more choices for consumers, more diverse service offerings and lower rates." Am Tel & Tel. Co., 75 FCC 2d 288, 288 (1980) (removal of restriction on the use of international telephone lines for data applications), aff'd sub nom. Western Union Int'l v. FCC, 673 F.2d 539 (D.C. Cir. 1982).
2. The FCC adopted an equipment registration program that limited restrictions on interconnection of equipment to those aimed at protecting the telephone network from technical harm. See Interstate and Foreign Message Toll Telephone, First Report and Order, 56 FCC 2d 593, modified on reconsideration, 58 FCC 2d 716 (1976);

Second Report and Order, 58 FCC 2d 736 (1976), aff'd sub nom. North Carolina Util. Comm'n v. FCC, 522 F.2d 1036 (4th Cir.), cert. den., 434 U.S. 874 (1977).

3. International Competitive Carrier, 102 FCC 2d 812 (1985), recon den., 60 Rad Reg. 2d (P&F) 1435 (1986).

4. Cf. Comsat Study--Implementation of Sec. 505 of the International Maritime Satellite Telecommunications Act, 77 FCC 2d 564 (1980) and Changes in the Corporate Structure and Operation of the Communications Satellite Corp., 90 FCC 2d 1159 (1982), Second Memorandum Opinion and Order, 97 FCC 2d 145 (1984) (analysis of Comsat's corporate structure with an eye toward segregating competitive ventures from regulated activities) with the Third Computer Inquiry, Report and Order, 104 FCC 2d 958 (1986), mod. on recon. 2 FCC Rcd. 3035 (1987), further recon den. 3 FCC Rcd. 1150 (1988), partially reversed and remanded sub nom. California v. FCC, 905 F.2d 1217 (9th Cir. 1990).

5. See, e.g., Int'l Record Carriers' Scope of Operations (Gateways), 76 FCC 2d 115 (1980), aff'd sub nom., Western Union Tel. Co. v. FCC, 665 F.2d 1126 (D.C. Cir. 1981) (expanding domestic locations where international record carriers could accept traffic).

6. Inquiry into Policy to be Followed in Future Authorization of Overseas Service, Notice of Inquiry, 36 FCC 2d 605 (1972), Report and Order, 57 FCC 2d 705 (1976), reviewed sub nom. ITT World Comms., Inc. v. FCC, 555 F.2d 1125 (2nd Cir. 1977), policy applied, 75 FCC 2d 682 (1980), aff'd sub nom., Western Union Int'l v. FCC, 673 F.2d 539 (D.C. Cir. 1982) (allowing AT&T to provide data services); Western Union Int'l, Inc. 76 FCC 2d 166 (1980) (lifting restrictions on voice services provided by record carriers); Overseas Communications Services, 92 FCC 2d 641 (1982) (authorizing AT&T's entry into the international record services market).

7. See Policy for the Distribution of United States International Carrier Circuits Among Available Facilities During the Post 1988 Period, CC Docket No. 87-67, Notice of Proposed Rulemaking, 2 FCC Rcd. 2109 (1987), Report and Order, 3 FCC Rcd. 2156 (1988) (abandoning circuit distribution guidelines); Policy to be Followed in Future Licensing of Facilities For Overseas Communications, 30 FCC 2d 571 (1971) (setting forth policies for licensing transmission facilities in the North Atlantic region during the 1970's); Inquiry to be Followed in Future Licensing of Facilities for Overseas Communications, 62 FCC 2d 451 (1976) (planning up to 1985). For a detailed history of the FCC's loading policies, see Inquiry into the Policies to be Followed in the Authorization of Common Carrier Facilities to Meet North-Atlantic Telecommunications Needs During the 1985-1995 Period, Third Notice of Inquiry, 98 FCC 2d 1166 (1984); see also, Policies to be Followed in the Authorization of Common Carrier Facilities to Meet Pacific Telecommunications Needs During the Period 1981-1985(POR Planning, 102 FCC 2d 353 (1986).

The Commission traditionally used its public interest mandate to review Section 214 applications in terms of demand, costs, media and route diversity, restoration, intramodal and intermodal competition, technological innovations and international comity. See, e.g., Am. Tel & Tel. Co. et al, 4 FCC Rcd. 1129, 1131 (1988) (TAT-9 Authorization). But in Am. Tel & Tel. Co. et al, 4 FCC Rcd. 8042 (1989) (TPC-4 Authorization) the Commission concluded that the Communications Act of 1934 did not require it to undertake a facilities planning process before considering an application to construct a submarine cable system.

8. Int'l Competitive Carrier, 102 FCC 2d 812 (1985), recon den., 60 Rad. Reg.2d (P&F) 1935 (1986).

9. See Modification of Policy on Ownership and Operation of U.S. Earth Stations That Operate With the INTELSAT Global Communications System, 100 FCC 2d 250 (1984) (authorizing earth station ownership independent of a Comsat-lead consortium); Licensing Under Title III of the Communications Act of 1934, as amended of Private Transmit/Receive Earth Stations Operating with the INTELSAT Global Communications Satellite System, 3 FCC Rcd. 1585 (1988), aff'd sub nom TRT Telecommunications, Corp, v. FCC, 876 F.2d 135 (D.C. Cir. 1989) (authorizing end users to operate international transmit/receive earth stations independently of the carrier providing the space segment).

10. See Domestic Communications Satellite Facilities, 35 FCC 2d 844, 849 (1968).

11. See, e.g. Toward Europe-wide systems and services--Green Paper on a common approach in the field of satellite communications in the European Community, COM (90) 490 final, November 20, 1990 (proposal for substantial liberalization in satellite earth station ownership and access to satellite capacity).

12. Tel-Optik, Ltd. 100 FCC 2d 1033 (1985).

13. Pacific Telecom Cable, Inc. 2 FCC Rcd. 2686 (1987) (conditional authorization), 4 FCC Rcd. 8061 (1989) (final authorization).

14. Ronald Reagan, Presidential Determination No. 85-2, 49 Fed Reg. 46,987 (Nov. 28, 1984), implemented in Establishment of Satellite Systems Providing International Communications, 101 FCC 2d 1046 (1985), on recon. 61 Rad. Reg. 2d (P&F) 649 (1986), on recon., 1 FCC Rcd. 439 (1986).

15. Agreement Relating to the International Telecommunications Satellite Organization, done Aug. 20, 1971, 23 U.S.T. 3813, T.I.A.S. No. 7532 [hereinafter cited as INTELSAT Agreement].

16. Id. at Article XIV(d).

17. Senior Interagency Group on International Communication and Information Policy, "A White Paper on New International Satellite Systems," (Feb., 1985)

18. Establishment of Satellite Systems Providing International Communications, 101 FCC 2d 1046 (1985), on recon., 61 Rad. Reg. 2d (P&F) 649 (1986), further recon. 1 FCC Rcd. 429 (1986).

19. Pan American Satellite, Inc., 101 FCC 2d 1318 (1985) (conditional authorization), 2 FCC Rcd. 7011 (1987) (final C-band authorization), 3 FCC Rcd. 677 (1988) (final Ku-band authorization).

20. Communications Satellite Act of 1962, as amended, Pub. L. No. 870624, Sec. 191 et seq., 76 Stat. 419 codified at 47 U.S.C. Sec. 701(a) (1990).

21. Transborder, international services of domestic U.S. satellites required consultation with INTELSAT and addressed many of the economic harm questions raised by separate systems. See Transborder Video Services, 88 FCC 2d 258 (1981); Hughes Communications Galaxy Corp., 6 FCC Rcd. 297 (CCB 1991).

22. Orion Satellite Corp., 101 FCC 2d 1302 (1985) (conditional authorization), 5 FCC Rcd, 4937 (1990) (granting final authority to construct, launch and operate).

23. The INTELSAT Board of Governors did not expressly propose that the Orion Satellite system should be favorably consulted. Instead, it reported to the Assembly of Parties that it had received adequate assurances from the United States and other nations interested in supporting separate system market entry, that they would not oppose efforts on the part of INTELSAT to survive in an increasingly competitive environment. This apparently means that INTELSAT has the implicit approval to deaverage rates selectively to meet competition from separate systems.

24. See,e.g., Pan American Satellite, Mem.Op. Order & Auth, 6 FCC Rcd. 4610 (1991) (granting 100 64 kilobits per second-equivalent circuits for services interconnected with the public switched telephone network between the U.S., Dominican Republic, Eastern European countries not members of INTELSAT, Costa Rica, Bahamas and the United Kingdom); IDB Communications Group, 6 FCC Rcd. 2932 (1991) (use of Intersputnik for services not interconnected with the public switched telephone network).

25. Pan American Satellite Corp., Petition for Rulemaking to Modify Commission Policies Established in CC Docket No. 84-1299 Relating to Separate Satellite Systems, RM-7562 (filed July 18, 1990).

SATELLITE DATA BROADCASTING SYSTEM

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1.Abstract

Fujitsu has developed a point-to-multipoint data broadcasting system that uses communication satellite for domestic use. This is the first product in Japan for a data broadcasting system by satellite communication.
We will go on this development to enhance the services provided by this communication network and advance application development. We are also promoting the development of integrated multimedia satellite broadcasting network systems combined with existing networks.

2.Introduction

In the field of broadcasting business,Nipon housou kyokai (NHK) and Japan Satellite Broadcast corporation (JSB) have started direct television broadcast by using satellite. Because of the reduction of antennas size, the direct broadcast system(DBS) has devloped remarkably. And there are already several million subscribers. At the end of 1991,NHK will begin experimental broadcasts for high-definition TVs.
On the other hand in the field of communication business,Japan Communications Satellite company Inc. (JC-SAT) operates 64 transponders with two satellites. These transponders are used for CATV,satellite TV networks within companies, and other diverse applications. In addition, the following three companies are planning to launch satellites within five years. As the result of these launches the number of transponders will expand to 200.

- Space Communication Corporation (SCC)
- Satellite Japan Corporation (SAJAC)
- Nippon Telegraph and telephone Corporation (NTT)

The technology to use such transponders and the resulting applications will be diversified.

3.Background of Development

(1) Strategic points
One of the largest selling points of satellite communication is the simultaneity of information. Signals sent from a sending station can be received simultaneously at multiple points. Information broadcast systems can effectively utilize this function. (See Figure 1.)
Low speed rate broadcast systems have already been developed. But Fujitsu has developed a high-speed data broadcast system operating at 2 Mbps. It has the following advantages.

①Advantages for users

1:Multimedia information transmission
Various types of data handled by computers can be trasmitted rapidly regardless of the data type (ex. texts,graphics,realistic images and voices).

2:High speed transmission
This system is designed to send data at 2 Mbps rate. This system is hundreds times faster than existing systems.
With this high-speed transmission path of 2 Mdps, information provider (IP) can send a large amount of data (image data,CAD data,etc.) immediately to many points.

3:Economical information transmission
The transmission cost for each receiving stations can be reduced by sending information to multiple points by a single carrier. This means that the transmission cost can be devided by the number of receiving station.

②Advatages for system vendors
One network dose not need full band size of transponder. Each network needs 5MHz bandwidth. If the transponder bandwidth is 27 MHz,4 networks can be buildup.
Transponders can thus be used effectively by sharing the bandwidth.

(2) Technical points
The following require technical development to achive the above-mentioned advantages.

①High reliable transmission
This 2-Mbps transmission system needs 5 MHz bandwidth to achive high reliable transmission path. We adopt the following methods to this system:

- Setting the encoding rate of forward error correction (FEC) to R =1/2
- Binary phase shift keying (BPSK) modulation

This system broadcasts datas from the center

to the receiving stations. There is no returning transmission by satellite links. To improve the quality of the transmission path,highly-reliable error control systems are adopted. Bose-Chauduri-Hocquenghem (BCH) and BEST are performed three times each in addition to FEC.

②Small-sized antenna for receiver

A small-sized antenna with a diameter of 60 cm (standard) can be used because of adopting a triple error correction system.
This system enables a low bit error rate (BER) of 10^{-8} at a high operating ratio (99.9% or higher) even such a small antenna.
Besides,this system adopt a low noise block (LNB) amplifier because of the wide band of 5 MHz.
Since the antenna is small,it can be installed simply and inexpensively. Total communication cost is thus reduced.

③Flexible control of network structure by computers

Data is sent to specified destinations which are managed as a group in the network data base at the center. Receiving stations are registered under each group.
Information in this network data base is distributed to receiving stations via satellite communication lines. When a receiving station receives a broadcast from the center,it extracts only the data addressed to itself based on the received network data base.
The network structure can be changed by modifying this network data base and sending the data base information. These operations can be executed by the center computer. The network can thus be modified flexibly.
Interception of data can be prevented by sending a new cryptographic key at a same time to transmit the network data base. This function enables data security.

4.System Configuration

This system consists of the following center equipment and receiver equipment. (see Figure 2.)

(1)Center equipment

The center equipment receives information from IPs by the terresttrial line and transfers it to satellite links. This equipment consists of the following devices.

①Communication processor

This device is connected to the IP host computer via ISDN (※1) lines. It performs the following processing:
- Packet assignment sent data and conversion to satellite protocol
- Accumulation of packet data
- Management of transmission scheduling

The communication processor can be connected to IPs by the general-purpose protocol of TCP/IP (※2).

※1 ISDN: Integrated Services Digital Network
※2 TCP/IP: Transmission Control Protocol/ Internet Protocol

②Network management processor

This device manages all data bases related to the network (network configuration ,IP information,etc.).

③Sending terminal station

For error correction,this station encodes the data sent from the communication processor. Then,it performes scramble processing and modulation with the BPSK method.
It also provides an interface for directly storing the lines from IPs.

④Earth station

This station converts the transmission from sending terminal station into Ku-band signals of 14 GHz and transmits to the satellite.

(2)Receiver equipment

Receiver equipment receives data from satellite links and send it end terminal such as personal computers.
This equipment consists of the following devices.

⑤Receiving antenna

Antenna receives transmission from the satellite. An offset parabolic antenna with a diameter of 60 cm is used.

⑥Tuner

Tuner demodulates the 1 GHz signals, and extracts data stream of 2 Mdps.

⑦Decorder

Decoder corrects errors with the error correction codes included in the received signals and decodes cryptographic codes. It then extracts the data addressed to this station. And it send the data to the end terminals.
There are two types of interfaces with terminals:
- TTY transmission with RS-232C
- Connectionless trasmission with Ethernet

5. Services Provided by This System

This system provides various services for IP. The services are classified into two types depending on the satellite line use mode:
- Packet transmission
- Transparent transmission

Table 1 outlines the functions.

(1)Broadcast service with packet transmission

The sending center receives data sent with

file transfer from an IP. It performs packet assignment and multiplexes the data with that from other IPs. The broadcast services are then provided through satellite lines. The broadcast services with packet transmission are classified into realtime broadcast service and accumulated broadcast service.

①Realtime broadcast service
Data is sent to the satelite line as soon as it is received form an IP. This service is effective for realtime applications.

②Accumulated broadcast service
Data received from IPs is accumulated. It is sent to the satellite line at the time specified by IP. The accumulation period is from two days before to one hour before. This service is effective for applications which send a large amount of data periodically or those which send the same data repeatedly.

(2)Broadcast service with Transparent transmission
The lines from IPs are directly stored,and the satellite lines divided with time division multiplex (TDM) are provided as transparent transmission paths. The path is provided exclusively as leased line.
The line speed is 64 kbps,192 kbps,384 kbps,or 1.5 Mbps.
This service is effective for transmitting non-accumulated data,such as voice data and compressed moving image data.

6. Target Markets of the Services

One of the targets of this system is to distribute a large amount of data immediately to multiple points at a low cost. To examine practical applications, we evaluated the economical efficiency of this system.

(1)Economical efficiency
In general, using satellites requires a high cost for transmission facilities and transponders. We examined the economical efficiency of the system assuming that ten IPs share a sending center and a transponder.
We assumed a broadcast system with 64-kbps ISDN as the object of comparison. The result is shown in Figure 3. For users who send 1M-byte of data (about ten compressed realistic images) per day,satellite use is more advantageous for 11 or more receiving station. For users who send 5 M-bytes of data (about 50 compressed realistic images),satellite use is more advantageous for 4 or more receiving stations. As a result,using this system is more economically efficient when immediate broadcast is performed to receiving points of over ten stations.

(2)Application fields
As discussed above,this system is suitable for application that require immediate broadcast of large amounts of data. The system may be applicable to the following fields:

①Realtime and emergency Applications
- Distribution of financial information, agricultural products market information ,and technical information
- Online auctions
- Emergency notification (at disaster or accident)

②Applications requiring mass transmission
- Distribution of static image data base
- Distribution of software
- Distribution of voice and music

7. Examples of Applications

This section describes the network application examples for the following aplications:
- Distribution of financial information,which requires realtime transmission
- Distribution of used car auction information ,which requires simultaneity (See Figure 4.)

Stock prices,exchange rates, and futures quotations are changing constantly. It is necessary to distribute such information immediately according to changes. The satellite data broadcast system satisfies the requirements economically.
In auction,the images of desired articles need to be recognized. Graphic images on a personal computer are insufficient for this purpose; higher quality images are needed. A realistic image requires several times as much data as a graphic image. Besides,simultaneity of information distribution is very important even though to send a large amount of high qulity image data with telephone line costs expensive. The satellite data broadcast system solves such problems.
The organizer of an auction gets the data of the cars for sale,as realistic images,from video signals into a personal computer. The data in the personal computer is file-transferred to the satellite center. The center then distributes the data simultaneously to multiple receiving points. If someone wants to bid on a car,the receivers input the data to participate in the auction to the host computer of the organizer,through terrestrial lines.
The price and determination information of the auction is sent via terrestrial lines.
After the auction of a car ends,the information on the next car is distributed through the

satellite link.

8. Conclusion

Because of the advance of digital technology many kind of medias can be treated as digital data. To manage those datas efficiently is becoming important. And data transmission is one of the management.

While about 200 transpondars are going to be operated within five years in Japan, "Satellite data broadcasting system" which handls multimedia is very promising for cultivating markets in new fields. Fujitsu will provide integrated system integration (SI) services from system design to applications.

Table 1 List of service

Classification		Outline Outline of service	IP interface	End terminal interface
Packet transmission	Realtime broadcast	After reciving data sent with file transfer, immediately broadcasts by packet transfer	Physical IF : ISDN 64 Protocol : TCP/IP	Physical IF : RS-232C or Ethernet (10 base 2) Protocol : TTY (for RS-232C) specific protocol (for Ethernet)
	Accumulated broadcaststst	Accumulates the data sent with file file transfer until the specified time. Broadcasts the data by packet transfer at the specified time		
transparent transmission		Provide four type of line (64 kbps, 128 kbps, 386 kbps, and 1.5Mbps) in 2 Mbps satellite line for IPs as leased line	Physical IF : High-speed digital leased line Protocol : non (transparent)	Physical IF : High-speed digital leased line Protocol : non (transparent)

Table 2 Specification of system

Items	Contents
Satellite	Ku-band communication satellite
Frequency	Up link : 14 GHz Down link : 12 GHz
Transmission rate (includes error correction code)	2 Mbps
Modulation method	BPSK
Threshold error rate	10^{-8}
Method of error correction	FEC (R=1/2, K=7) BCH (63 : 56) BEST
Network size	100.000 Receiveing stations for 1 center
Interface	For IP packet transmission : ISDN 64 transparent transmission : High-speed digital line For Terminals packet transmission : RS-232C or Ethernet transparent transmission : High-speed digital line

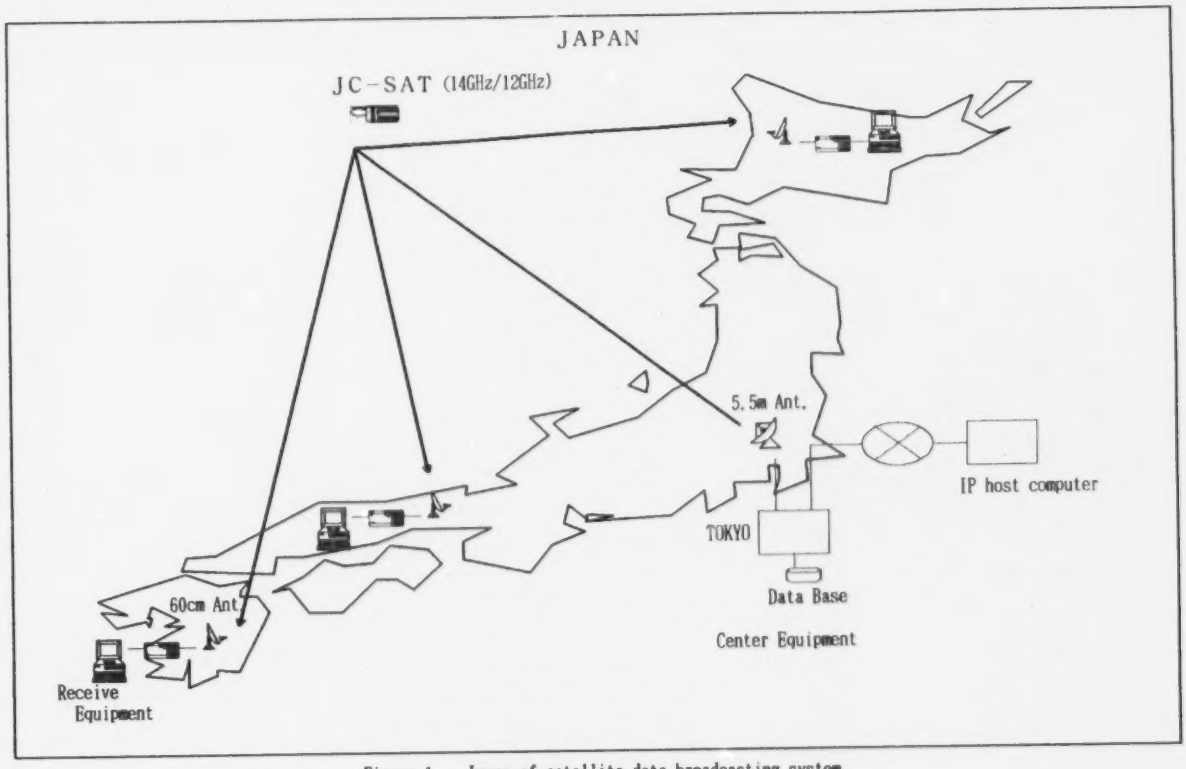


Figure 1 Image of satellite data broadcasting system

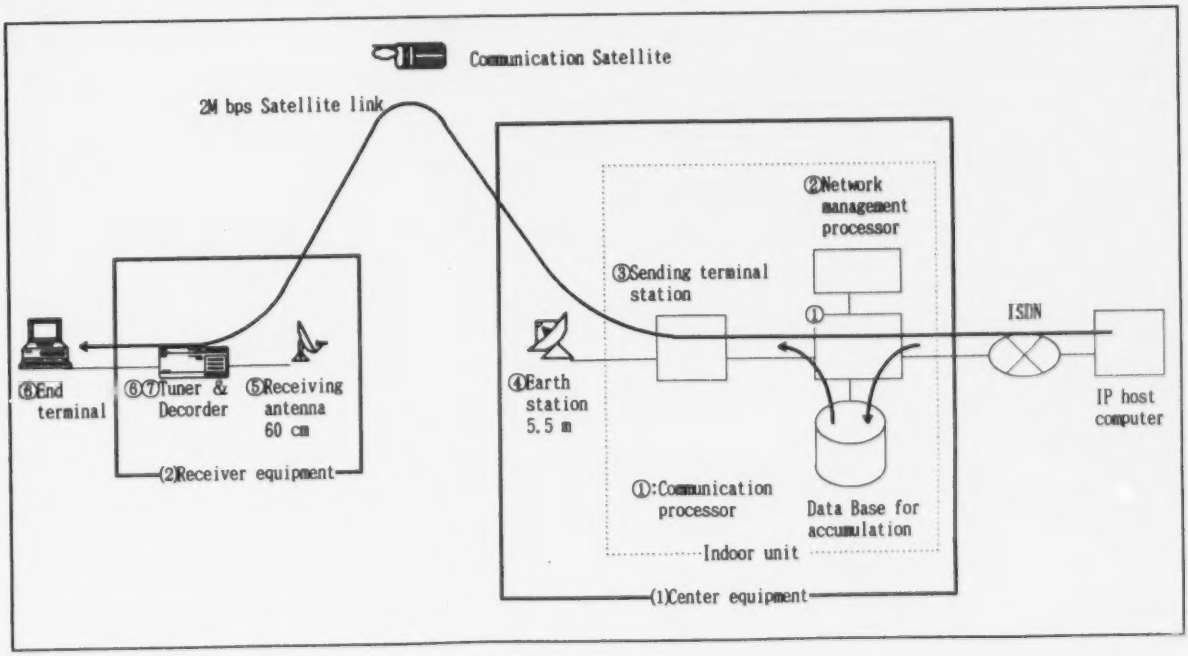


Figure 2. Image of System Configuration

BEST COPY AVAILABLE

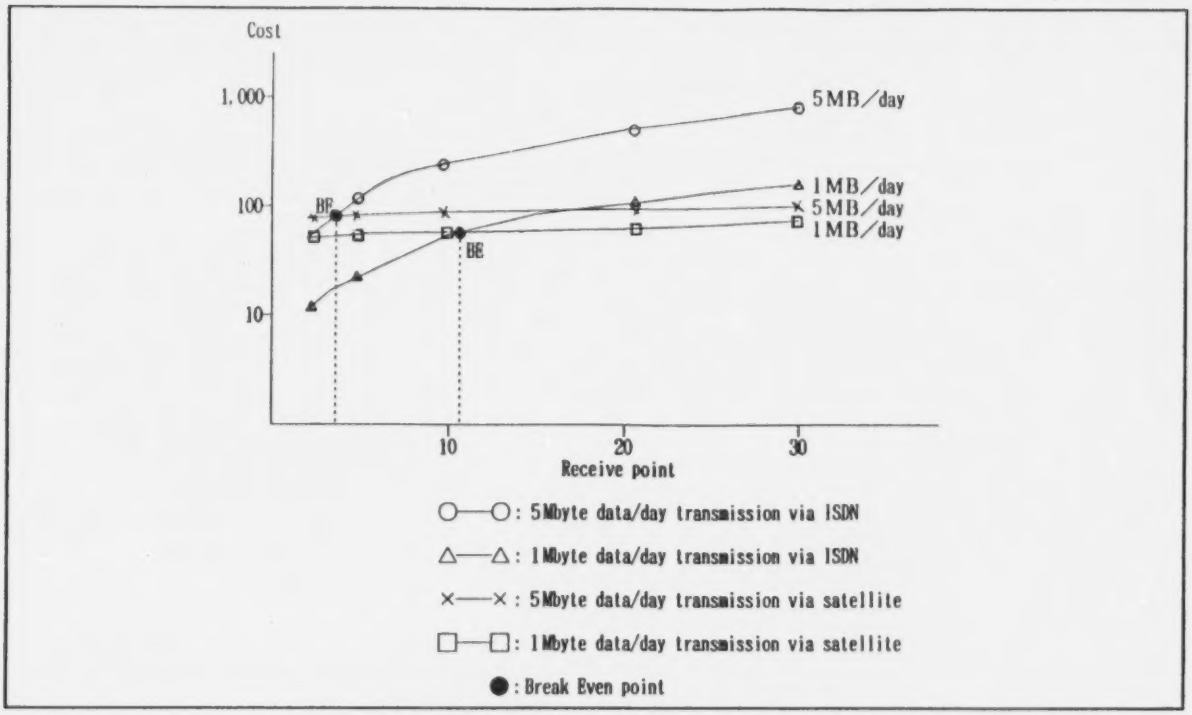


Figure 3 Economical Comparison of Satellite and ISDN transmission

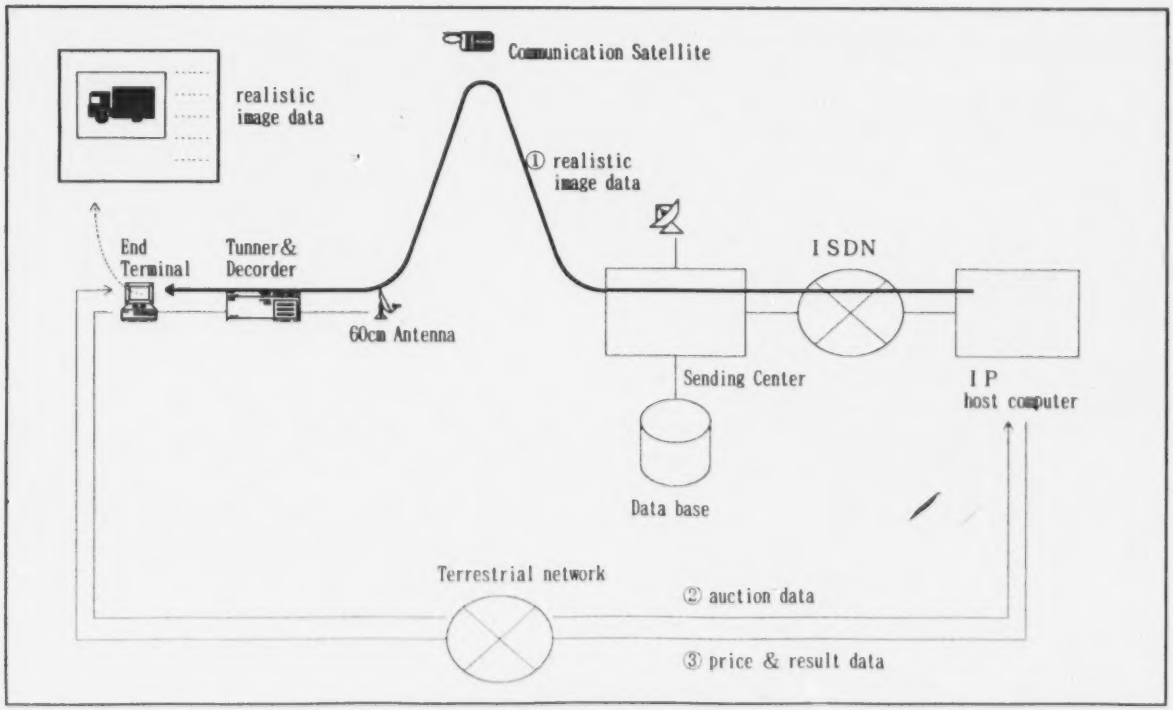
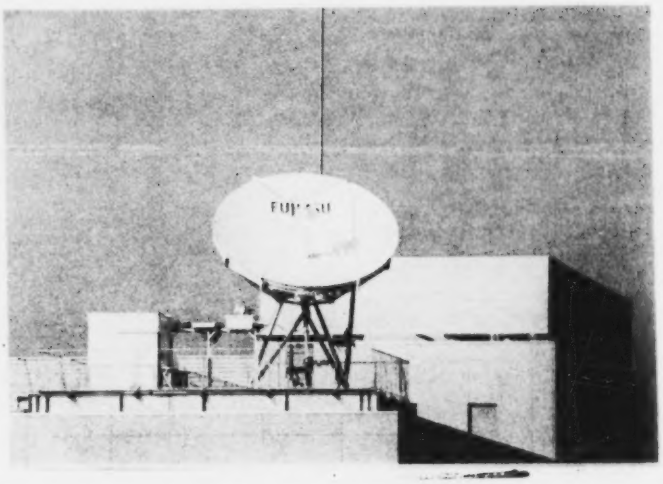


Figure 4 Example of Used car auction system



(1) Center Equipment : Earth station 5.5 m antenna

(2) Center Equipment : Indoor unit
(from left side,Network managent processor
,Communication processor
,Sending terminal station
,and display,printer for
communication processor)

(3) Receiver Equipment : from left side
,60 cm antenna
,Tuner (top side unit)
,decorder (bottom side unit)

A Communications Platform for Road Traffic Management

A paper presented to the 1992 Pacific Telecommunications Council Conference

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This paper outlines work done by Telecom Australia's Corporate Customer Division as part of the scope of the Transport Management Information Systems (TRIMS) agreement between Vic Roads and Telecom.

The paper describes a study undertaken to assess the performance of Vic Roads existing operating systems, analyses the communication requirements of future systems and recommends the selection of a communications platform to meet Vic Roads current and future needs.

1. INTRODUCTION

TELECOM AUSTRALIA

Telecom is the government owned telecommunications carrier which operates in Australia. From January 1992 a privately owned competitor will be able to compete with a new company which will result from the merging of Telecom and the Overseas Telecommunications Commission. The new company will be known as AOTC.

The principal business of Telecom is to supply telecommunications services within Australia and from 1992 Telecom (AOTC) will operate globally.

Some highlights from the 1989/90 year include;

A trading profit of	$1.291	Billion
New capital works	$3	Billion
New optic fibre	182,000	Kms
Revenue	$8.8	Billion

Telecom and OTC are active in international markets with major contracts being awarded in Saudi Arabia Pakistan and Vietnam

ROADS CORPORATION (VIC)

Vic Roads is the State Government Authority which is responsible for the Management of the road network in the state of Victoria as part of the overall transport system. Through this resposibility Vic Roads in association with other government agencies contributes to the social and economic development of Victoria.

Management of the road network includes ; planning, design, construction and maintenance of roads, Registration and licensing of vehicles, licensing of drivers, traffic management and information and road user services.

Key aims are developed in the areas of; Road Safety, Access and Mobility, Economic Development, The environment and Commercial Services.

In 1990 ther were 3 million registered vehicles and 2.7 million licensed drivers.

Some key information follows;

Capital Expenditure	$333	million
Recurrent Expenditure	$343	million
Employees	5,596	
Non Current Assets (inc roads,land,bridges etc)	$8	billion

Vic Roads is active internationally with projects being undertaken in Fiji, Thailand, Indonesia, Singapore, Ireland, New Zealand and Western Samoa.

1.1. Background

Telecom has entered into an agreement with Vic Roads to act as Project Managers and System Integrators on behalf of Vic Roads for the introduction of new technology enabling improvements in the efficiency and effectiveness of road transport.

This agreement, known as Transport Information Management Systems(TRIMS), is for five years (90/91 - 94/95) and the work undertaken in the first year (90/91) will determine project activities to be undertaken in subsequent years.

Part of the scope for the first year entails development of a communications platform to support the systems developed orproposed.

Vic Roads have a vast communications network infrastructure supporting existing operational systems. This network infrastructure is built from a variety of technologies including slow speed telemetry, data , voice and video networks.

With the development of new operational systems, it is now opportune to take advantage of advancements in communications and related technologies and develop a platform to support both existing and proposed systems.

To that end, this study reviews existing telecommunication facilities and defines a strategy plan upon which Vic Roads can design and implement a communications platform to help meet its business objectives.

1.2. General

Although this study was carried out as a joint process between Vic Roads and Telecom, considerable consultation was undertaken with industry specialists, transport user groups, interstate road traffic authorities and public transport authorities as to the requirements that must be met by this platform.

The study considered existing operational systems and in particular concentrated on the performance and cost effectiveness of these systems.

The study also investigated proposed systems Vic Roads wish to implement and has recommended a strategy plan to achieve this.

Special attention was given to both the direction that the international community is taking in developing communication platforms and incorporating standards.

2. STUDY OUTLINE

2.1. Study Objectives

The objective of this study as defined by Vic Roads is to:

"Develop a cost effective, standards based, communications platform providing improved efficiencies that will support existing and proposed operational systems"

2.2. Scope Of Study

The scope of this study is to assess the performance of existing Vic Roads operational systems and analyse the communication requirements of these and future systems to enable a communication platform to be developed to support them.

Recommendations presented address the issues identified in the original Project Management Plan which were:

i. Identify all services currently supporting Vic Roads operational systems together with the costs of these services. The report will assess the performance of the existing platforms.

ii. Investigate Vic Roads existing and future systems in order to understand and specify particular requirements of each system;

iii. Make recommendations for short and long term improvement in the delivery of Vic Roads operational systems including cost benefits;

iv. Define a long term strategy plan for the development of a communications platform supporting both existing and future operational systems.

3. VIC ROADS OBJECTIVES

3.1. Business Objectives

In order to design a communications platform to assist Vic Roads in achieving their business objectives, it is necessary to identify what these objectives are:

Vic Roads Business Objectives have been identified as

- Road Safety

  To achieve a safe road system for the people of Victoria.

- Customer Service

  To provide information, financial and technical services to clients on a commercial basis.

- Road Network Access Management

  To assist the efficient movement of people and freight and to improve access to services for all transport users

- Economic Development

  To assist economic growth by improving the effectiveness and efficiency of the transport system.

- Road System Environmental Enhancement

  To be sensitive to the environment through management of the transport network.

3.2. Functional Objectives

In developing a communication platform it is necessary to identify the broad functional objectives that Vic Roads have in place to achieve their overall business objectives. Consistent with Vic Roads Business Objectives, the wider functional objectives for achieving them have been identified as:

- Provide information to directly influence future land, travel and infrastructure planning decisions. Vic Roads require accurate data on the current performance of the transport network in order to plan and optimise the network to meet the needs of users.

- In planning a trip, allow the decision-maker:

  - to have available all the options by which a trip can be made

  - understand the implications of the potential trip

- Provide the decision-maker with the necessary information required to make an informed decision on how to best meet his transport needs, within imposed restraints.

- In making a trip, make the trip-maker accountable for the cost and other consequences of the trip. Ensure the user limits travel to essential purposes therefore maximising the fficient use of natural resources and minimising theimpact on the environment.

- Provide an infrastructure which:

  - represents an optimum use of community resources
  - protects and enhances the environment
  - operates at maximum achievable efficiency. The transport infrastructure must be cost effective in its operation and management.

. Provide the means to measure and report the performance of the various components of the transport system.

The TRIMS project team is currently developing vehicle management, guidance and information systems to assist Vic Roads in achieving these functional objectives. These systems will provide the mechanism by which Vic Roads will measure the performance of the traffic network, provide a management facility and enable a more efficient use of the network.

It has been agreed that in developing technological solutions to meet the above objectives, a communication platform to support the information capturing and processing systems will be required.

The communications platform will form the common link upon which a number of systems will interface.

3.3. Key Requirements

The following Key Requirements describe the characteristics that Vic Roads require from a communications platform.

. Open Communications

The communication platform must be "open", i.e. provide for the development of any future systems and for the services to be available from a number of suppliers i.e. vendor independent.

. Support Existing Systems

The platform should support or provide a migration path for existing systems. The degree to which this can be achieved will be dependant upon how the existing systems have been implemented.

. Cost Effective

The platform should provide a mechanism to help achieve cost effective business practices. This can be achieved by providing the present communications functionality at less cost or by offering improved functionality for a similar cost.

. Support The "Plug In" System Concept

As Vic Roads will be continually developing and upgrading systems, the platform must enable Vic Roads to implement technology and systems with negligible effect on other users or provide Access To Other Agencies, Businesses and Individuals

Organisations such as the Royal Automobile Club of Victoria(RACV), Public Transport Authority (PTC) and various transport user groups will require access to the systems operated by VicRoads. The communications platform must facilitate and manage the availability of information to agencies, businesses and individuals.

. Network Management

The facility should be available to continuously monitor and manage the platform to ensure the highest level of performance is maintained.

4. EXISTING OPERATIONAL SYSTEMS

4.1. Overview

With Vic Road's formation, a compilation of systems originally designed and implemented by various statutory bodies, i.e.Road Traffic Authority of New South Wales (RTA (NSW)), Melbourne Metropolitan Board of Works (MMBW), now Melboune Water The Road Traffic Authority (RTA), The Road Construction Authority (RCA) and Federal Government, have now been brought together.

These systems were implemented independently and therefore without any strategic direction being adopted for their development or networking.

Consequently there are a large number of systems supported by various technologies and standards, none of which is judged as an appropriate platform for the development of future systems.

4.2. Assessment Of Vic Roads Systems

An investigation into the performance of these systems was undertaken during the course of this study. The conclusions that have been reached are as follows:

i. Basic Technology

These systems were developed to fulfil simple requirements.

With budgetary restraints and simple applications to be met, developers used basic or "bare bones" technology when designing systems. This technology includes simple hardware platforms supported by proprietary protocols.

Further, some of these systems were developed more than 20 years ago with technology that was, in its day, state of the art but now is considered to be rudimentary.

The continued use of these technologies restricts migration of these systems away from existing communication environment to modern, more cost effective solutions.

ii. Standards

The communication protocols used for the existing systems, are generallynot based on international or industry based standards. The systems were largely developed with proprietary protocols, thus limiting migration to more sophisticated technologies.

iii. Scope For Improvement

Although all systems proved to be satisfactory in terms of meeting VicRoads requirements, Vic Roads feel there is scope to improve aspects of The SCATS, the Ericsson freeway phone systems and the Video surveillance(Closed Circuit TV) network. These aspects are:

a. Sydney Coordinated Adaptive Traffic System (SCATS)

Maintenance Costs

Improvement To Algorithm

Utilisation Of Modern Technological Developments

A business case for the redevelopment of SCATS has been prepared by theTRIMS project team and is discussed in detail in the TRIMS business cases report.

b. Ericsson Freeway Phone System

Due to the age and type of technology used in the Ericsson freeway phone system it has become difficult to maintain and will not permit more than one driver to communicate with the control room at any one time. Vic Roads have begun to implement the preferred option i.e. a PABX system.

c. Video Surveillance (CCTV)

Due to the type of technology currently used to support this system, it is not possible to cost effectively implement this network outside theCBD or freeway environments.

v. Cost Effectiveness

The bulk of the communication costs are for SCATS. Vic Roads have optimised the costs for this system by placing the regional computers so that private line costs are minimised.

The remaining costs are for data services, video services and telephone call charges and are minor in relation to the costs for SCATS.

Given the design, type of technology used and the application, there is negligible scope to improve on the cost effectiveness of the these present communications.

Migration to any other type of communication technology would require expensive redevelopment costs which could not be justified by reduction in costs on improvement in performance etc.

5. STANDARDS BASED MODEL

5.1. Open Systems Interconnect (OSI) Communications Model

In designing a communications platform meeting the Key Requirements outlined previously, it is necessary to adopt a communications architecture based on recognised standards.

The Open Systems Interconnect (OSI) model, has been developed by the International Standards Organisation (ISO) as a non proprietary standards based architecture against which organisations can develop communications systems.

Although there are many communication models and architectures available today only the OSI model is recognised as nonproprietary. Communications platforms developed against this model will therefore support all international standards and so the adoption of the OSI model will enable Vic Roads to achieve their key requirements.

5.2. Standards

An "OPEN" communications environment can only be implemented by the adherence to standards to ensure that system components are alike, not only within the system itself but within other comparable systems that are likely to interface to or work with that system.

This fact has been recognised too, by both the European and North American road traffic authorities as they now attempt to develop standards-based traffic management systems similar in function to those that Vic Roads wish to implement.

A standards based platform will meet Vic Roads Key Requirements by providing the following:

- Avoid duplication of equipment and information
- Allow information to be located where it can best be managed, yet enabling access to such information at the point of use
- Avoid restriction to a single equipment suppliers product strategy
- Avoid restriction to a single communication suppliers services
- Allow individual procurement of discrete systems
- Maximise the potential for interworking between separately procured systems, whether within Vic Roads or with users outside Vic Roads
- Simplify future introduction and integration of equipment to meet unforeseen application requirements
- Establish a common technical approach to complement and encourage the realisation of Vic Roads IT strategies
- Achieve genuinely open, and hence more cost effective, communication systems. Enable greater marketing opportunities for systems developed by Vic Roads. Greater exploitation of systems developed on recognised standards can be achieved rather than those developed on proprietary systems.

5.3. Communications Protocol

Before a Communications platform can be recommended it isnecessary to select a communications protocol on which this platform will be based.

The communications protocol will need to:

- Be standards based in order to provide an "OPEN" system and
- Support the communications requirements of Vic Roads future systems.

5.4. OSI Protocols

The Open Systems Interconnect (OSI) defines two network architectures or topologies that can be implemented to support a network over a wide area. These are:

- Dedicated Network (point to point) and
- Packet Switched Data Network (PSDN).

To support these communications architectures, OSI specify communication protocols based on the CCITT Recommendation X.25.

X.25 is a suite of protocols defined between layers 1 and 3 inclusive of the OSI model. This is a stable recommendation and implementations of this protocol are widely available.

5.5. Support For Multipoint Networks

OSI does not presently define standards for multipoint networks. As Vic Roads require a standards based communications platform no consideration has been given to a recommendation based on multipoint networks as any implementation would be proprietary.

5.6. Selection Of A Communications Protocol.

The X.25 suite of communications protocols will be used in the implementation of this platform. This will offer Vic Roads arange of standards-based protocols to support the future systems being developed for this platform. X.25 is also the standard upon which the Australian Government Open Systems Interconnect Profile (GOSIP) is based therefore the adoption of this recommendation will ensure that Vic Roads are compliant with the Federal Governments commitment to OSI.

6. FUTURE OPERATIONAL SYSTEMS

6.1. Overview

In June 1990, a joint Telecom - Vic Roads study was conducted to systematically analyse data to plan, manage and operate the road and traffic system in Victoria.

The emphasis of this work was to identify where new technologies could be cost effectively applied to the capture and management of information about road activity.

As an outcome of this value management study, it was identified that VicRoads needed to implement new data collection and management systems to support the operation of the road network.

These systems included:

- Vehicle Management
- Route Navigation
- Transport User Information Systems
- Vehicle Movement Statistics
- Public Transport Information System
- Radio Data Service (RDS)
- Vehicle Guidance

Currently there are a number of business cases being developed under the scope of the TRIMS agreement addressing these projects.

These business cases include:

Vehicle Tagging Trials

A before and after traffic study for a major freeway project

The business cases define the relationships between the systems and:

i. Strategic model developed as part of TRIMS

ii. Value management study conducted as part of TRIMS

iii. Overseas developments

The business cases will define the scope in terms of objectives of each project.

6.2. Communications Requirements

As the technologies to be used in these systems have not been determined it is not possible to identify specifically what communications requirements need be supported by the communication platform.

Preliminary work completed to date by the TRIMS project team has identified the communication characteristics and technologies that need to be supported by the communications platform.
These are:

i. Support of a large number of dispersed sites (At least 200-300)

ii. Support for low to high data transfer (4KBYTES to700MBYTES/site/day)

iii. Support of both continuous and intermittent (low duty cycle) traffic patterns.

iv. Support CCITT Recommendation X.25 communication protocols

v. Support for CT2 and GSM technologies.

7. MAJOR ISSUES

In order to propose a technically feasible solution it is necessary to identify the major issues that may influence how that solution is implemented.

These issues are actually the difference between the "IDEAL" and the deliverable solution. By identifying these issues, it is possible to design a technically feasible solution and identify what constraints need to be overcome in time, so that the "IDEAL"solution can be achieved.

The following major issues were identified during the course of the study as being most likely to impact on the studies recommendations.

i. Availability Of Technology

the timing for the introduction of new technology may not now allow for the implementation of an ideal solution.

It may be necessary to implement a solution in a phased manner to ensure Vic Roads gets the ideal system in due course.

ii. Cost Effective Solution

Although solutions may be feasible, they may be too expensive to cost justify.

iii. Flexibility In Migrating Existing Systems

Depending on the technical restraints imposed by existing systems, there may be limitations in how quickly these systems can be integrated into the proposed platform.

iv. Availability Of Funds

Availability of funds may influence the implementation of solutions proposed in this study.

8. COMMUNICATIONS PLATFORM OPTIONS

8.1. Options

In meeting the requirements discussed in section 6, three options have been assessed. These are:

i. Utilise The Existing SCATS Private Line Network

ii. Private Packet Switched Network.

iii. Public Packet Switched Network

8.2. Recommended Option

It is recommended that Vic Roads adopt a public ISDN Packet Switched service to support the future operational systems currently being developed.

An ISDN network will offer Vic Roads the following benefits:

- Cost effective packet switched service.
- Standards based network.
- Support for CT2 and GSM technologies.
- Migration path to future communication developments.

Will support the redeveloped SCATS system.

8.3. Costs

As an indication to the cost of implementing a network to support VicRoads future systems, indicative Telecom tariffs have been used. With the deregulation of the communications industry similar services will be available from the second carrier and tariffs may reduce.

i. Remote Site

Each remote site will require an ISDN Basic Rate Access. The ISDN not only provides access to the ISDN public packet service but also support wide band width services e.g. Video Services, CT2/GSM etc. at these sites.

ii. Host Site

The host site will require access to ISDN. Initially a Basic Rate Access will accommodate the expected traffic but in time as the traffic increases this access may need to increase.

Table 8.1 details the costs for a 200 site network.

COSTS

Site	Installation	Ongoing
Remote 200	$122,000	$580,000
Host	$610	$2,900
TOTAL	$122,610	$582,900

TABLE 8.1

8.4. Implementation Strategy

A two stage strategy plan is recommended for the implementation of this communications platform. This plan recognises that the introduction of a communication platform must be achieved over a period of time. It also recognises that there are existing systems for which it would not be cost effective to migrate to a new platform in the short term.

The strategy adopted is designed to best suit the development of VicRoads systems.

It is proposed to install the communications platform to initially support the future systems then, over time, interface existing VicRoads and "Non Vic Roads" systems e.g. PTC, PMA, Trucking companies etc, into the platform, either by specifying interfaces into the platform or by providing gateways.

i Stage 1: Implement Future Systems

This stage will encompass the implementation of the network to support future systems. As these systems are developed and implemented the communication services required to support these systems will be installed.

These services will interface the end systems i.e. roadside devices,detectors and transponders to the central or host computers. and will form the basis upon which the overall communications platform will be developed.

ii. Stage 2: Interface To Other Systems

To enable information to be collected from other Vic Roads systems and also provide access into the TRIMS systems for other transport user groups e.g. PTC, PMA, Trucking companies, RACV etc, it will be necessary to recommend the interfaces necessary for this information transfer.

It is beyond the scope of this paper to define these interfaces in any detail as the systems that this communications platform must support have not yet been developed.

9. RECOMMENDATIONS

9.1. Preparation Of A System Strategy Plan

It was recommended that Vic Roads prepare a strategic plan for the on-going development of existing and future systems.

The strategy plan should address the following:

- Assess the types of systems needed to meet Vic Roads ongoing requirements
- Plan for their introduction including the phasing out of obsolete systems
- Oversee the development and implementation of new systems
- Ensure that new systems are standards based.

9.2. ISDN be implemented to support the following future systems:

- Vehicle Management
- Vehicle Guidance
- Public Transport Information system

ISDN provides:

- A cost effective packet switched service.
- A standards based platform.
- An interface to CT2 and GSM.
- Migration to future communications technologies and standards.
- A platform to support the proposed redeveloped SCATS.

9.3. Existing Systems

i Retain Telemetry Systems On Existing Platform

It is recommended that the existing telemetry systems i.e. incident detection, telemetry (Westgate bridge and pumping stations), weight in motion and traffic statistics systems are maintained on their existing platform i.e. private lines/DDS.

These systems are cost effective with the existing platform meeting the communications requirements of the applications. Migrating present systems to another communications platform would require a complete redesign and both from a performance and financial viewpoint, could not be justified .

ii Replace Existing Ericsson Freeway Phone System.

It is recommended that the Ericsson Freeway phone system be replaced. This system has become unmaintainable. The most cost effective option is the implementation of PABXs to replace the Ericsson concentrators. Implementation of this option has commenced.

In summary the proposed communications platform will begin to be implemented during 1992.

Initially it will be used to carry TRIMS demonstration applications and surveillance video.

As the TRIMS,SCATS and other road user systems are specified then the recommended ISDN based communications platform will be utilised by Vic Roads.

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A New Traffic Information Service Delivered over the Cellular Mobile Phone Network

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ABSTRACT

A new traffic information service delivered over the existing communications media is proposed. In this service, users directly access a traffic information database via the cellular mobile phone network, and get personalized and real-time traffic information through spoken explanations. This is the most important difference between the newly-proposed service and the existing information delivery media like radio broadcast, or audiotex, which delivers general information at predetermined intervals. The new service concept is verified by in-company demonstrations.

1. INTRODUCTION

Heavy traffic jams in metropolitan areas are a serious problem world-wide. In the Tokyo Metropolitan Area, the average driving speed has declined from 13.4 miles per hour (1980) to 9.1 miles per hour (1985). If the public sector could invest unlimited sums in road construction, the problem could be alleviated. However, Japan has a very dense population and land costs are very high. Therefore, road construction in Japan needs large investments and is not cost effective. That is why road construction in Japan has not eliminated or alleviated traffic jams. Although traffic has drastically increased over the last 10 years as show in FIGURE 1, the effective road length in Japan has remained almost the same. This has really aggravated traffic conditions in Japan.

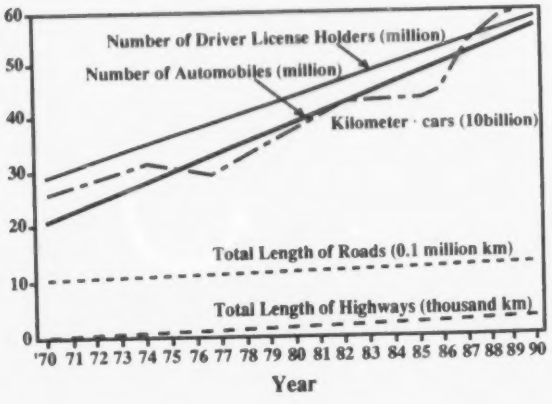
Number of Driver License Holders (million)
Number of Automobiles (million)
Kilometer · cars (10billion)
Total Length of Roads (0.1 million km)
Total Length of Highways (thousand km)
60
50
40
30
20
10
0
'70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90
Year

FIGURE 1: Factors Aggravating Traffic Jams in Japan

In such cases information about road conditions becomes extremely valuable, a cost effect system is needed that can supply realtime and personalized information. In many countries in the world, traffic information is delivered through traditional media like radio broadcasts. In several countries, as well as Japan, new traffic information services have been proposed. However, the existing and planned information delivery services are not effective. The proposed system, which fully uses the existing electrical communications infrastructure, can eliminate heavy traffic jams. This paper introduces the prototype of a new traffic information service offered through an existing cellular mobile phone system.

2. THE PROBLEMS OF EXISITING AND PLANED IN FORMATION DELIVERY SERVICES

Our prototype was developed after examining current and planned traffic information delivery services. The details of the services are shown in the references. Such information delivery services are divided into the following three types;

(1) delivery by public broadcast, i.e. TV or radio,
(2) delivery by interaction between a human operator and the user,
(3) delivery by networks and terminals dedicated to traffic information

As shown in TABLE 1, each type of service has its advantages and drawbacks. TABLE 1 summarizes the advantages and drawbacks of each service.

Service Type	Advantage	Drawback
(1) Broad Cast	Cheap Wide-Spread Terminal	Not Real Time Not Personalized
(2) Human Operater	Human - Friendly Understandable Realtime Personalized Wide - Spreaad Terminal	Large Operation Cost Small Capacity
(3) Exclusive Network and Terminal (planned)	Realtime Perconalized Good MMI	Large Inverstment Long Time Preparation

TABLE 1: The Advantages and Drawbacks of Each Known Service

In service (1), the information is delivered through TV or radio broadcasts. It can also be delivered through audiotex and videotex services accessed through the telephone network. In Japan, a multiplex broadcast system overlaying the existing FM system is also planned for traffic information delivery. In these services, it is difficult to deliver personalized information in real-time because only common information can be delivered at predetermined intervals. However information delivery is inexpensive and common existing terminals can be used such as radios and televisions.

Service (2) is supported in Tokyo Metropolitan area. The human operators sit in front of panels that graphically display the current traffic situation. The operators interpret the situation, and deliver the information needed through direct telephone interaction with the caller. The problem of this service is its small capacity and large cost. This service is not efficient and cannot accept a large number of calls, because the productivity of human operators is limited. In addition, the labor costs aggravate the cost-efficiency of this service. Thus, private organizations are effectively locked-out and only public organizations supported by taxes can offer the service. However, it is very flexible and human-friendly because the operators are highly trained and can understand and meet the user's requests and needs by interacting with him. Based on the user's requirements, they can deliver personalized information. The operator can even understand the extent of the caller's geographic knowledge and explain the situation in a way that best fits the caller. The operator not only delivers realtime traffic information but sometimes can forecast the expected changes in the situation and guide the driver to the best route. Since the interactions between the operators and the users are in the form of speech, the traditional telephone network can be used.

Service (3) is now under investigation for future commercialization. There were two traffic information delivery services of this type planned for the Tokyo metropolitan area. The first one was called RACS (Road Automobile Communication System) and had been developed under the guidance of the Ministry of Construction for the delivery of traffic information about the Tokyo Metropolitan Expressway. The second service was called AMTICS (Advanced Mobile Traffic Information And Communication System) and had been developed with the support of the National Police Agency for all roads in the Tokyo area except expressways. The basic concept of these services was similar and they were merged to one integrated system called VICS (Vehicle Information and Communication System) last fall. They use an exclusive communication network and terminals to accept users' demands and deliver information. This demands large investment and long preparation time. These are the major problems of the service. However, this service will be able to deliver personalized and realtime traffic information because the terminals are directly connected to the traffic information center. Since the terminals can be newly designed for this system, a comfortable man-machine interface could be offered.

3. OUR SOLUTION TO THE PROBLEMS

Our prototype service is based on an assessment of the current and planned traffic information delivery services and incorporates the merits of the above services while eliminating their problems.

In Japan, facilities for collecting traffic information like sensors or cameras have already been installed on roads and highways by the public sector. The information collected is transferred in realtime to a traffic information center, processed, and stored in the database.

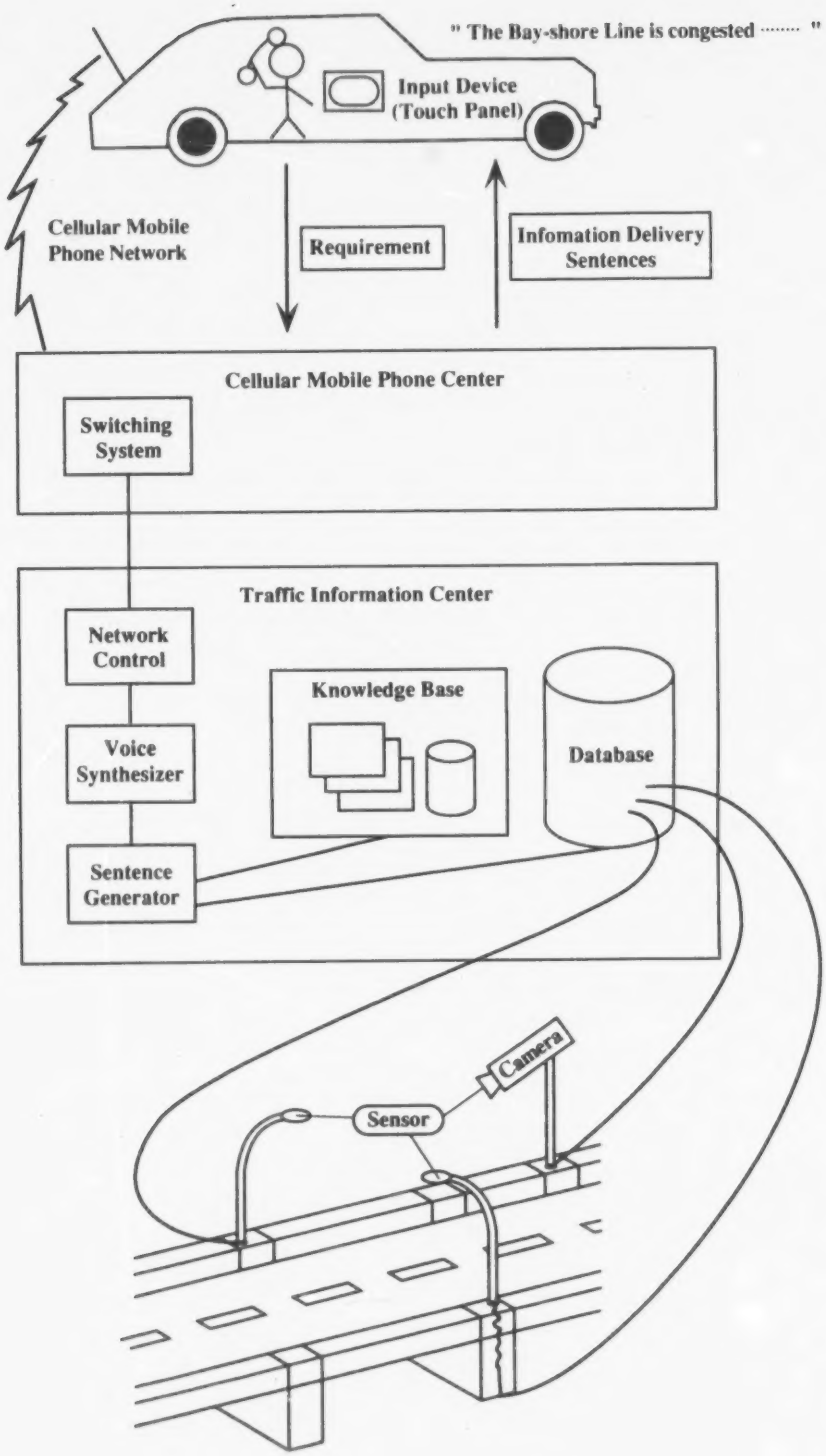

FIGURE 2: The Outline of Our Service

FIGURE 2 outlines the configuration of our service system. It is composed of user terminals (cellular mobile phone, with input capability), and a center machine (virtual database, knowledge base, reasoning module, a sentence generator, a speech synthesizer, and a network controller). The system has not yet incorporated the sensors, the switching and the transmission system, and the network controller. We built a proto-type with the minimum functions necessary to demonstrate the concept and the effectiveness of the service.

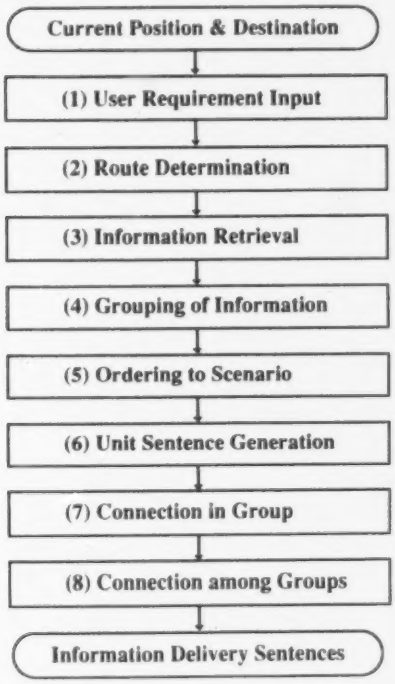

FIGURE 3: The Information Delivery Sentences Generation

In the system, traffic information is delivered following the procedure shown in FIGURE 3. Traffic information is retrieved from the database in the traffic information center and delivered as appropriate. (1) The system accepts the user's current position and destination (FIGURE 4) and (2) determines the shortest route connecting the two points. The knowledge and algorithm for route selection are stored in the knowledge base. (3) It then retrieves the information associated with the route from the traffic information database. Since it retrieves information on demand, users can get the latest information. (4) The pieces of retrieved information are grouped based on the interrelations among them. The interrelation most often identified is the causal relation between an accident and the congestion up to the same point in the same lane. The identification rules are also stored in the knowledge base. (5) The groups of information are ordered along the direction the driver needs to take. The order is the scenario of the information delivery sentences. (6) Each piece of information is converted into a unit sentence and the sentences are grouped following the grouping of information. (7) In each group, the unit sentences are connected following the interrelations identified beforehand. (8) The grouped sentences are finally connected following the scenario. Finally, completed sentences are converted into speech and delivered to the user.

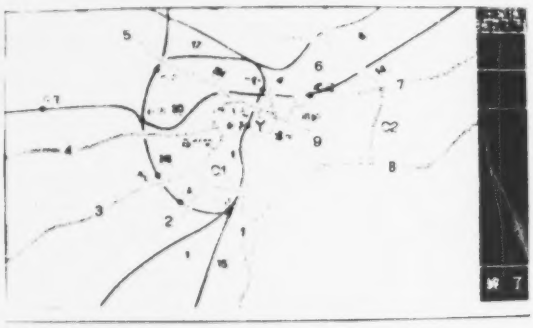

FIGURE 4: A Displayed Map for User Input

Since the information is delivered as speech, users can access traffic information centers through the most widespread communication tool, the telephone and they don't have to purchase new expensive terminals. Since the information is delivered on demand, it is realtime. As shown before, this service can deliver personalized information by retrieving the information on the route the user needs to travel. The automatic service, no human operators are needed for information distribution, drastically decreases the operation cost while offering virtually unlimited capacity. Explanatory sentences are designed to be as human-friendly as the human operators through the employment of modern natural language processing technologies and knowledge processing technologies.
The introduction of this service, which requires comparatively small investment, will ensure the efficient and effective use of the expensive traffic network through traffic redistribution.

4. EXAMPLE OF HOW OUR PROTO-TYPE SYSTEM WORKS

An example of how our proto-type system works is shown below.
Suppose that the database records shown in FIGURE 5 are extracted from the database as the records associated with the selected route.

Rec.ID	Topic	Line	Lane	Start	End	Length
1	Accident	No.3	W-bound	Gaien-RP		
2	Congestion	No.3	W-bound	Gaien-RP	Shinjuku-RP	1.0 miles
3	Maintenance	Loop	Inside	Ginza-RP	Shimbashi-RP	0.5 miles
4	Control	Loop	Inside	Ginza-RP	Shimbashi-RP	0.5 miles
5	Congestion	Loop	Inside	Ginza-RP	Shibakoen-RP	1.5 miles

FIGURE 5: Extracted Records

The interrelated records are then grouped and the interrelations are identified. In this case, records 1 and 2 are grouped into group 1 and identified with causal-relations. Records 3, 4, and 5 are grouped into group 2. The two groups are ordered following the route the driver will take. Thus the final form of extracted information is given in FIGURE 6.

Grp.ID	Rec.ID	Topic	Start	End	Length	Relation
1	1	Accident	Gaien-RP			Cause
	2	Congestion	Gaien-RP	Shinjuku-RP	1.0 miles	Result
2	3	Maintenance	Ginza-RP	Shimbashi-RP	0.5 miles	Cause
	4	Control	Ginza-RP	Shimbashi-RP	0.5 miles	Sub-Cause
	5	Congestion	Ginza-RP	Shibakoen-RP	1.5 miles	Result

FIGURE 6: Final Form of Extracted Information

Each record above is converted into a unit sentence (FIGURE 7).

Rec.ID	Sentence
1	There was an accident at Gaien-RP on the Westbound Lane of the No.3 Line.
2	The West-bound Lane of the No.3 Line is crowed starting from Gaien-RP back toShinjuku-RP for 1.0 mile.
	• • •

FIGURE 7: Unit Sentences

The sentences are connected to each other in a group following the interrelations among them (FIGURE 8).

Rec.ID	Connected Sentence
1 & 2	Because of an accident at Gaien-RP, the West-bound Lane of the No.3 Line is crowded back to Shinjuku-RP for 1.0 mile.

FIGURE 8: Connected Sentence

Finally, the sentences are connected among groups and the final information delivery sentences are given as follows.

"Good morning. Because of an accident at Gaien-RP, the Inside Lane of the Loop Line is congested back to Shinjuku-RP for 1.0 mile. Next, because of the lane control needed for road maintenance at Ginza-RP, the Inside Lane of the Loop Line is crowded for 1.5 miles back to Shibakoen-RP. Please drive safely."
(Original Japanese texts are translated into English for the convenience of explanation.)

5. CONCLUSIONS DRAWN FROM THE IN-COMPANY DEMONSTRATION

The in-company demonstrations last fall confirmed the desirability of the following characteristics;

1. personalized information
2. real-time delivery
3. low cost and large capacity
4. use of widespread access terminals, the telephone

6. FUTURE DEVELOPMENTS

In spite of the many plaudits received by the system during the in-company demonstration, the following 3 points were suggested.

1. The service is too effective. Too many drivers will follow the information provided thus rapidly changing the traffic situation. An algorithm which can forecast the consequences of the information provided and a feedback system that can dynamically change the route folloowing the consequence of the forecast should be developed.
2. New equipment that is easy to operate and compatible with the existing cellular mobile phone system should be developed.
3. Existing voice and natural language synthesis techniques need further improvement.

From now on, we will continue to enhance the prototype system and try to put it into commercial use. We will also try to expand the service fields. The system and its techniques are applicable to weather forecasting, stock market information, etc.. They can also be applied to network operations such as the notification of switching system problems.

ACKNOWLEDGEMENTS

We wish to express our deep appreciation to Dr. Yoichi Sakai for his helpful guidance in this project and to all the members of our research group for detailed comments on the content and style of this paper.

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The Airline Industry:
Major Customer and Innovator on the Thin Routes of the Pacific

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1. Abstract

The small airlines of the Pacific and the tourism industry they support need good data communications to compete internationally. The telecom services tend to be expensive and often not readily available. Solutions can be found through new and flexible use of technology and international cooperation.

Despite their size almost all of the small countries of the Pacific have a national airline which requires good data communications to compete internationally. This communication requirement is a significant expense for the airline which is a major telecom customer in its home country. Airlines have the potential to contribute much to the economy but they also can lose substantial sums -- sums which dwarf the income of the PTT. Computer reservations and telecom at AMI runs about 4% of revenue, in line with what other airlines spend. While airlines complain about the costs they have no choice but to pay whatever is required for an effective computer reservations system (CRS). Ordering a reservations circuit in any major city in the world is a simple matter; in the small islands nations of the Pacific it is simple too -- after you have the first system installed.

2. AIR Marshall Islands Network Overview

The AIR Marshall Islands (AMI) data network is diagrammed in Figure 1. Parts of the network are provided by the Societe Internationale de Telecommunications Aeronautiques (SITA) and the rest are varied set of private circuits leased or constructed by AMI.

SITA is the international aviation telecom cooperative. Its global network, a one half billion dollar per year enterprise, is essential to small airlines because it can take traffic from almost any city world-wide. If it is to your advantage to bring your data down in country X then you can do so if you are a SITA member. The main thrust of SITA is that competing airlines join together to meet their communication requirements. In most but not all cases it is less expensive to have SITA transport your data than to lease a private circuit. In the jargon of today, SITA is a provider of virtual private networks for the transactional data, SITA Type A (reservations), and operates several powerful electronic mail systems built originally on telex machines (Type B). (AMI, based on 1990 usage, holds two of the 7,825 shares in SITA. Lufthansa has the most, 390).

SITA also provides essential connections to aviation manufacturers, suppliers, and increasingly, the Transport Related Sector, a diverse group including, for examples, customs offices, tour wholesalers, CRS's., and freight forwarders. All of these are important to the success of an airline.

Most of the Pacific island communication providers are governments or government-owned corporatized organizations--i.e. defacto PTT's. Thus the services and charges are not necessarily determined by the market. This can work to the advantage of the local airline when, for example, favorable tariffs are granted. It works against the airline when there is a lack of flexibility in the services offered or higher than necessary costs.

The health of the travel industry depends in large part on the extent to which the governments and government telecom agencies recognize the need to provide the services the travel industry requires at fair prices. While the PTT's are monopolies the airlines are not and must hold down costs. Air trade agreements usually provide for reciprocity. This means that if my national air carrier can carry passengers to your country, your national carrier can carry passengers to mine.

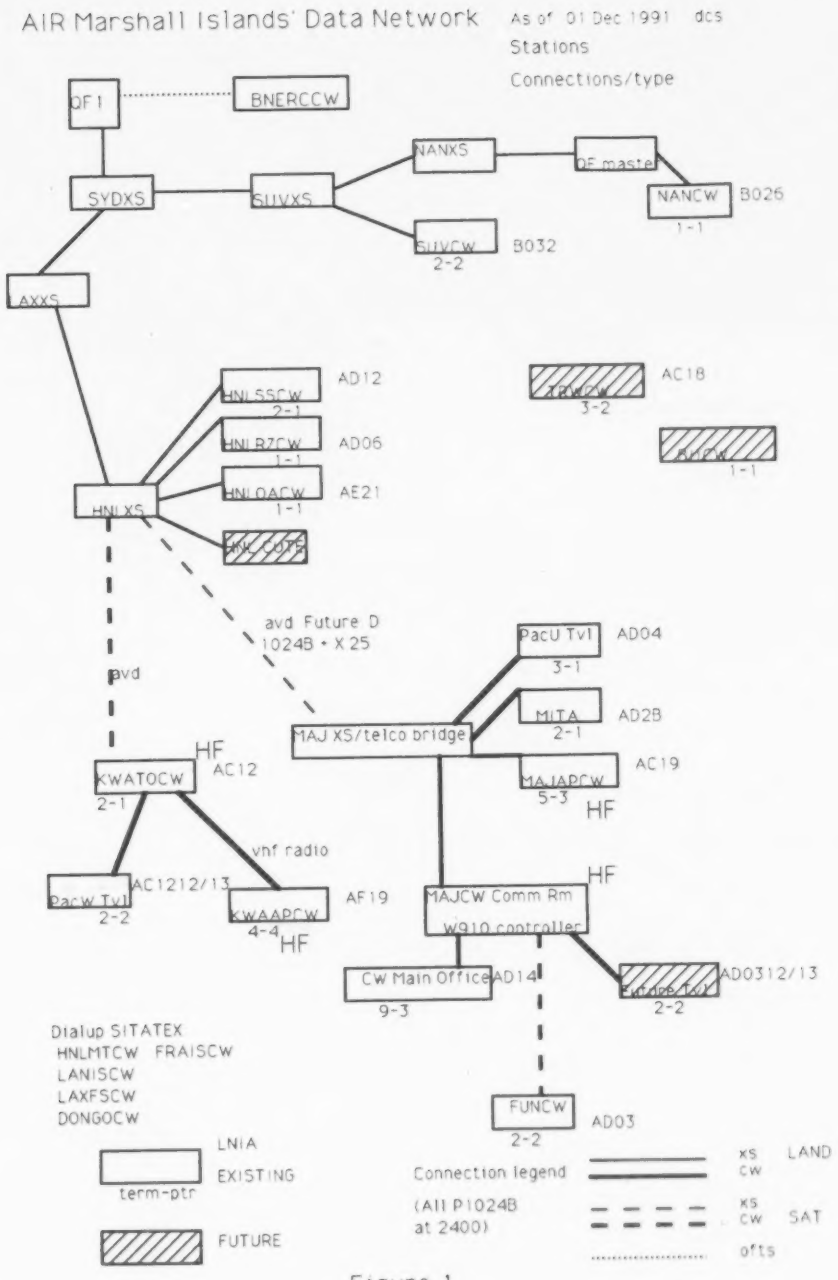

AIR Marshall Islands' Data Network
As of 01 Dec 1991 dcs
Stations
Connections/type
OF1
BNERCCW
SYDXS
SUVXS
NANXS
OF master
NANCW
B026
1-1
SUVCW
2-2
B032
LAXXS
HNLSSCW
2-1
AD12
HNLRZCW
1-1
AD06
HNLOACW
1-1
AE21
HNLXS
avd Future D
1024B + X25
avd
PacU Tvl
3-1
AD04
MiTA
2-1
AD2B
MAJ XS/telco bridge
MAJAPCW
5-3
AC19
HF
KWATOCW
2-1
AC12
HF
vnf radio
Pacw Tvl
2-2
AC1212/13
KWAAPCW
4-4
AF19
HF
MAJCW Comm Rm
W910 controller
HF
CW Main Office
9-3
AD14
AD0312/13
2-2
Dialup SITATEX
HNLMTCW FRAISCW
LANISCW
LAXFSCW
DONGOCW
FUNCW
2-2
AD03
LNIA
EXISTING
term-ptr
FUTURE
Connection legend
(All P1024B
at 2400)
xs
cw
LAND
xs
cw
SAT
offs

Figure 1

AMI has had discussions or actual circuit leases in four small island countries and three of them made offers which are substantially better than those received from major metropolitan countries -- including the U.S., Australia, and New Zealand. The small countries need the tourism income and air service and so make concessions to help. Despite the concessions, in all cases the telecom carrier would still have revenue which substantially exceeded costs. Airlines can use their knowledge, contacts, and increased business volume to help reduce costs further. Cost sharing is critical on the thin routes -- thin in terms of both telecom and air traffic.

One of my favorite examples is the little country of Tuvalu (pop. 9,000) 600 nmi. miles north of Fiji both because its policy on data communications is progressive and because success was made possible by contacts made at PTC. As part of the agreement allowing AIR Marshall Islands to use the air trade rights of Tuvalu, AMI was to use its best efforts to install computer reservations. Although the Australian government had given a VISTA earth station to Tuvalu its OTC could not provide any data service at an affordable rate. Furthermore OTC said there was no space segment available. Since INTELSAT was moving a higher capacity satellite to 174 deg. E in 1990 we knew that there was in fact some bandwidth available.

Armed with a letter from the Tuvalu Government we approached INTELSAT which assured us it would make available the space segment if we could find a place to bring it down. After searching the Pacific and finding no country willing to take the other half circuit we said why not use the PACT network equipment in the Majuro earth station. After consulting some knowledgeable people we felt confident our plan would work and the relevant government ministers of the Marshalls and Tuvalu met and the deed was done. We use an off-the-shelf Westinghouse W910 controller to make terminals in Tuvalu look to the CRS like they are in Majuro. Tuvalu has also invited us to find others to share the cost of the circuit. We also want to thank OTC for their assistance after the space segment issue was resolved.

The Marshall Islands also offers some additional examples of flexibility in telecom policy which assists the airlines. The first is access to the spectrum for VHF and UHF links. That is how we get our data to and from the high-tech U.S. missile testing facility at Kwajalein.

The second is easy access to the HF spectrum for voice communications and packet data.

The third is that AMI supplies the systems and data for automating travel agencies. This allows some cost sharing and makes it easier to get our product to the public. There are three competing CRS's delivered to the Marshall Islands so we do not have the luxury of a monopoly.

And fourth, customer premise equipment (CPE) is deregulated.

Although the above activities are grandfathered under the present telecommunications law we continue to push for more flexibility and lower costs in data communications while recognizing that the Marshall Islands National Telecommunication Authority needs some protection from predation on voice. It makes sense for us to look after our data needs and those of related businesses because we have the equipment, training, and expertise to deal with our specialized requirements.

Living in a competitive world ourselves, we would like PTT's to succeed through business acumen and technological wizardry rather than the force of monopoly. We believe that if the PTT's can maintain flexibility and openness to alternative technological solutions, the airlines can devise methods of data distribution that are both effective and affordable. The airlines, together with the banks, form a critical mass for data communication that can make data services affordable for other sectors. We could afford to give communication capacity to educators in the evening for its low marginal cost, for example.

3. Cost Reduction and Control

The major cost of a computer reservations system is telecom. AMI pays only about $30,000 per year for computer reservations but about $270,000 per year in the telecom to support it. With that level of spending is is apparent that we are interested in reducing costs and getting more for our money. The data requirements are modest in terms of volume. What is important is the response in seconds to a reservation request, and the electronic messaging facilities. There are a number of approaches which could produce cost reductions.

3.1 Asymmetric Bandwidth

The flow of data is asymmetric -- the flow outward from the CRS is more than four times that from the remote terminals. This is because very short commands often produce several screens of data.

Thus asymmetric bandwidth would be appropriate -- say 4800 out from the CRS computer and 1200 from the remote terminals toward the CRS. This alone could produce substantial savings. This limited return bandwidth is often easy to find in the satellite channels allocated to telex.

3.2 Use of Standard Protocols

Much of the airline reservations traffic is in protocols which are airline industry specific. For example the P1024B protocol used by AMI is a polling method using six-bit characters and synchronous circuits. This is easy to implement using simple analog bridges but wastes most of the circuit capacity waiting for polling responses with satellite delay.

The airline industry is moving toward X.25 but a useful concurrent move might be to jump directly to a frame relay approach due to the high quality of the circuits these days.

An important benefit of using a standard data protocol is that it can be transmitted by a number of carriers. As long as we run an airline protocol we are locked into SITA except where we can or must rent a private circuit. And while SITA is a responsive service provider, it too is learning to be flexible in the remote islands, and amid world-wide deregulation.

X.25 is a good interim approach because it can be implemented quickly and modern communications processors can be restructured later to new protocols with simple software changes.

X.25 is also attractive because it can be run asynchronously and thus data can be made to fit around voice traffic. It typically takes several seconds to get a response from a reservations computer so a few extra milliseconds delay to fit data around speech would make little difference to reservations terminal users.

How might such a mix of X.25 data and voice be used? In some countries there is a great reluctance to request an additional SCPC satellite voice circuit for dedication to data even if the airlines can afford to pay for the service. In this case the solution is to convert the circuit to data and then with the appropriate commercially - available black box mix data and voice on the circuit. The PTT takes the voice and uses it as it always does and then gives the data to the airline. This solution would be appropriate between Majuro and Ebeye in the Marshall Islands.

At one point we came close to using a VSAT to serve Tuvalu. The major capital cost turned out not to be the earth station but hardware and software to convert the airline protocol to X.25. Direct use of X.25 by CRS's is slow in coming due to existing investment however we expect it from our CRS, Qantam, in 1992 thus making it easier to serve remote locations. (We abandoned the VSAT idea after Tuvalu asked us to figure out a way to use its VISTA earth station.)

X.25 is easy to extend to the farthest parts of the network -- the remote airports having only one or two flights per week. The technology is that adapted from the amateur radio equipment. While AMI has done some successful experiments with packet equipment, it is hard to beat the human operator signal processor who checks in periodically with his SSB radio and picks the reservation request out of the noise. Our more modern, safer aircraft are also more expensive. Just one unnecessary flight avoided or extra one added can pay for the radio for an outer island agent. (For a few dollars more an INMARSAT C terminal would work well also.)

However good our outer island human signal processor is, she cannot afford to sit by the radio all day for part-time pay. Fortunately inexpensive SSB radios and computers can be connected so that short messages can be delivered as hard copy. Getting through reliably on HF is usually a matter of picking the right frequency for the time of day. A modest personal computer is well suited to managing such tasks. Small hotels and resorts on the outer islands can also be tied into global reservations through X.25 connections. The airline will help because travelers need places to stay.

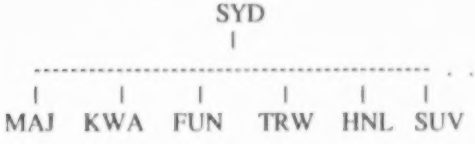
We intend to add X.25 data along side our P1024B data so as to provide new services we presently lack including credit card verification, exchange of interairline agreements and documents, cargo management, and access to aircraft parts and maintenance databases.

Some airlines such as Solomon Airlines have used dialup connections for traditional computer

reservations but the cost per minute was high and the CRS did not want to provide storage for the messages that accumulate while there was no connection.

4. Data Broadcast

A point to multi-point system featuring more efficient use of space segment capacity could be set up without any immediate change of protocols, although change of protocols is inevitable. In the simplest scheme, data could be broadcast from Sydney on one SCPC channel and received at six points. Instead of requiring 12 SCPC space segments the following network would require only seven -- one outbound and six returns. Of course the six returns need not have very large bandwidth. They would not need a full voice band SCPC circuit and could take diverse routings. In the future a TDMA approach might be used for return links.



Broadcast from a hub with varied return circuits.

This broadcasting of data from the CRS host should be done using efficient digital methods which are available off-the-shelf. As usual there is good reason for airlines to share capacity for distribution. The large bandwidth could also be used during relatively idle periods such as the middle of the night to transmit` databases or maintenance manual revisions.

While airline data is unencrypted now some modest encryption might be wise if large amounts of data from many airlines were being broadcast.

Point to multi-point tariffs do not break new ground. We would also like to note that INTELSAT is a hero for us who inhabit the hole in the middle of the Pacific between the hemispherical and/or regional offerings of INTELSAT and others. INTELSAT global beams are all that is available on many of the thin routes and we want to stress, reasonably priced. It is the markups of the telecom carriers that some times make bandwidth unaffordable. We expect future INTELSAT offerings in the central Pacific to open more opportunities.

5. Facilitation of Innovation

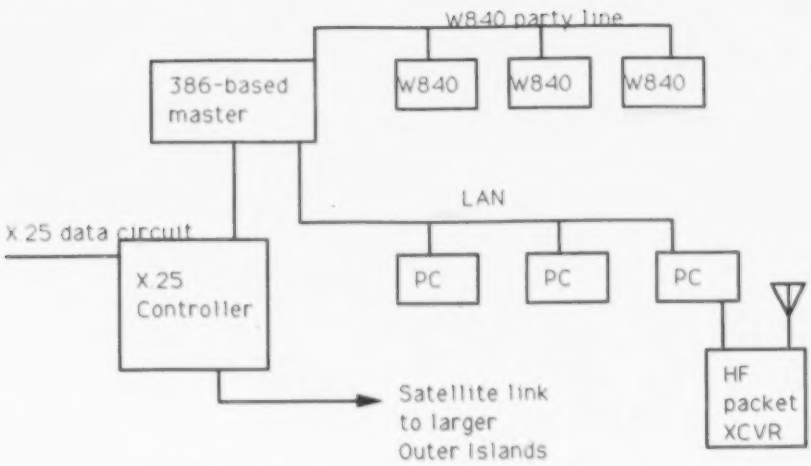
Often the airline industry can propose conceptual approaches but the small PTT's have no place to turn for validation or modest amounts of engineering so as to act on our requests. Also for those PTT's that may be listening, the airline industry does not always know all the answers but is certainly willing to engage in constructive dialog along the lines of, "How can we make this work." International telecom organizations such as the Forum and SITA can provide the contacts and solutions to our problems which are big in island terms but get lost in the noise of data requirements in metropolitan countries. As members of SITA airlines can influence its priorities.

Government to government discussions are critical in many cases. It is easy to find a technical solution if the governments have agreed on an appropriate policy. For example we perceive that the Australian government policy is to promote digital circuits -- despite their giving analog earth stations in their international aid program. All that is needed in many cases to go digital is to change the modem or tap into the digital interface of the existing modem thereby earn a digital tariff. Would airlines pay the capital cost? Surely. The payback period is well under a year. The missing link now is for island governments to raise the issue in the appropriate meetings. To be effective however international experts must know what equipment is actually installed.

In our experience many equipment vendors are eager to help solve interesting problems even though the sale is small. However in the case of large companies it can take a lot of work to find the right person.

'Digital VISTA' is a concept we would like to see implemented because it will bring affordable and reliable data communication with the outer islands. Solutions are readily available commercially as can be confirmed with several vendors regularly present at PTC.

The PC computer revolution makes it easy to change protocols and user software. Whereas before everything was dedicated -- terminals, circuits, modems, mainframes -- today arrangements can be changed frequently. Equipment costs continue to decline and this makes new solutions affordable. With a good 386 PC as a base changing protocols may only involve $500 worth of new software or at worst a couple of



NEXT GENERATION AMI RESERVATIONS OFFICE

Figure 2

thousand dollars for new communications processor board and software.

We do not anticipate buying many more dedicated reservations terminals. In 1992 the computer and communications facilities of our offices will be reorganized along the lines shown in Figure 2. Notice that both a LAN and a W840 party line are driven by a PC.

A year and a half ago it was cheaper to route our data via the long route from Kwajalein to Honolulu to Los Angeles to Sydney. In 1992 some other arrangement may be more cost effective. If I want a new arrangement to get data from Honolulu to Sydney all I need do is pick up the telephone, get a few quotes and make a decision. In the remote islands the project often is more complicated as it involves everybody from international organizations, to national governments, to the person stringing the wire for the last mile.

6. Conclusion

The thin routes of the Pacific require flexible approaches to provision of airline and tourism data services. Because the projects are small they necessarily must take timely advantage of available resources and opportunities to remain affordable and help make airlines commercially viable.

If the airlines are seen to be pushy from time to time it is because they spend a lot of money on telecommunications and financial success depends on the quality of their data networks. On the plus side airline data networks are of sufficient size that they open data opportunities to communities in their markets.

TOURISM IN A GLOBAL CONTEXT: THE CASE OF FREQUENT TRAVELER PROGRAMS

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International tourism integrates itself into the complex world of contemporary global affairs through its dependence on telecommunications technologies and its tolerance for widely fluctuating political, economic, and social conditions. A little explored area which illustrates the relationship of telecommunications and tourism in terms of factors of globalization is the frequent traveler program concept.

Introduction

The world's infrastructure has been transformed radically over the last 30 years largely as a result of political, geo-physical, and technological developments. As a result, modern international relations have become characterized by a number of new participants, institutions, and issues beyond that of the conventional nation-state system. A subject area which illustrates well the integration and complexity of contemporary affairs is international tourism and its 1980s creation of the frequent traveler program concept. Although the nation state plays a primary role in the process, participants such as transnational firms are contributing both directly and indirectly to the creation of new institutions in the form of nongovernmental organizations and their activities. This generation of new issues is rendering the fields of international relations and international communication much more complex and their theories more diverse than ever before.

Tremendous changes in communication technologies and transportation over the last two decades have catapulted tourism into political, economic, financial, and cultural prominence as one of the world's most powerful agents in global economic development. In a certain sense, no international interaction is more at home than international tourism in today's globalizing world characterized by continuous and rapid change. The complex relationships between modern financial, technological, and information communication sectors are embodied in tourism, an industry designed to tolerate widely fluctuating political, economic, social, and ecological conditions. That the world has changed is apparent when orthodox economic and political models no longer are or are only partially operative. For example, it has become increasingly difficult to analyze international relations in the area of trade in services without incorporating into the equation such factors as international tourism, modes of international transportation, and flows of technological and financial data.

In the past, tourism was considered -- largely by those outside the field -- as a provincial, peripheral area of domestic and regional studies dealing primarily with commercial and business analyses and applications. Today, however, the multibillion dollar international trade in tourism and travel-related services has created an important sector of economic and cultural activity. Furthermore, the integration of communication technologies into the tourism industry is involving tourism in the politically charged areas of technology transfer and international trade in services, central areas of international political debate for the 1990s and 21st century. In this light, international tourism provides a unique laboratory for social science research.

As a form of international interaction, tourism integrates itself into the complex world of global economic and trade relations. As this occurs, the dependencies as well as interdependencies of tourism vis a vis other economic and financial sectors become more pronounced. Over the last ten years, there has been a direct relationship between international conflict, such as regional war, terrorism, and violence, and the level of instability of the international tourism market. No where was this better illustrated than in the recent Persian Gulf War where the international dimensions of conflict not only affected the flow of tourism worldwide but also demonstrated the close connections between financial, telecommunications, transportation, and accommodation firms and sectors.

The call today from within the U.S. tourism industry, and increasingly from outside, is for tourism to be recognized as a political imperative in the national interest -- economically, politically, technologically, and culturally. It can no longer be treated in economic isolation as a simple question of hardware, of who builds what building of who owns what air or ground transportation, hotel, 747 jumbo jet, or communication network. Growing emphasis on the software or human dimension, such as management, education, labor,

marketing, services, banking and credit, advertising and insurance, are blurring the boundaries between public and private, government and nongovernment, national and transnational interactions.

Similarly, the diminishing nature of the Cold War and the increased mobility of people and information across national boundaries, have created new dimensions of international relations and international communication. These new dimensions are highly complex and are interwoven with the old elements of governments and international organizations. Tourism is comprised of relationships among individuals, small businesses, national governments, and multinational enterprises which not only own the physical hardware superstructure but also now control access to and distribution of the tourism software infrastructure that shapes individual tourists' minds in terms of destinations. These entities are influencing interactions globally between governments, international organizations, and tourism policy fora, setting new theoretical agendas for contemporary international relations.

Tourism as International Relations

Elsewhere we have outlined a model for policy and research (see figure 1) in the form of an integrative model of tourism as international relations.(1) Figure 1 posits the international tourism infrastructure as a central hub in the interaction among issue areas and institutions comprising the international relations policy field.(2) This article focuses on the travel industry's competition over the last decade for the attention of the frequent business traveler, particularly the frequent flyer. It also examines the implications of industry-wide innovation, consolidation, and diversification for international relations.

Figure 2 illustrates the complex relationships between production and distribution, technological and human dimensions of the tourism infrastructure. The model delineates specific tourism items, such as frequent traveler programs, as tangible and intangible sources of power in a globalizing political and economic system. What is important in both models is the emergence of telecommunications technologies as the energy source holding the tourism infrastructure together as a system and stimulating its growth. Communication technologies offer the means for the formation and operation of many new transnational organizations and international institutions.

Frequent Traveler Programs

1. Frequent Travelers - International Tourism Consumers

International tourism has become a complex global process in the high speed movement and management of data and capital as well as of literally millions of world citizenry. The tourism consumer embodiment of this phenomenon is the frequent business traveler, more specifically the frequent flyer. It has become extremely difficult to assess the impact of one sector of tourism on another without taking into account the complexity of the entire system and its integrative nature. The result has been a changing conception of the tourist, and especially the frequent traveler, from an individualized commodity to a highly sophisticated consumer factor in international political economy.

The issue of the frequent traveler is a good illustration of the international tourism consumer category identified in the integrative model of tourism as international relations, illustrated in figure 1. Today's travel manager must conceive of tourism as characterized by global electronic communication networks dedicated to the movement and management of complex forms of information — the movement of people, of currencies, and of the telecommunications facilitating air, land, and sea transport. Today's frequent traveler, therefore, represents a means of achieving a number of highly important, strategic international business, financial, and policy objectives, both government and nongovernment.(3)

In other words, what the international tourism infrastructure has witnessed since World War II, and in explosive proportions in the decade of the 1980s, is the transnationalization of the communication base, often called the information communication revolution. Growth in transportation and telecommunications technologies has been the primary physical hardware mechanism providing for this transnationalization of the communication process. In the human software dimension, growth in world population, wealth, education, and commerce, especially in the industrialized countries, has accounted for acceleration of transnational travel to unprecedented levels. This process has been supplemented by the advent of communication technologies, especially those with tremendous financial applications, such as fiber optics, satellites, facsimile, telex, and computerized reservation systems (CRS). The introduction of jet aviation in the 1940s similarly parallels a diversification and expansion of telecommunications technologies. This reflects a direct involvement of citizens, in the form of tourism consumers, in the global network of communication and financial flows with the private sector playing a key role.

The transnationalization of the communication base through international tourism is an interlocking process. In response to the explosion in distribution of world travel, competitive pressures encourage technological innovations in and modernization of the worldwide tourism infrastructure in terms of global reservations and travel related services. In response to the increasing distributive power of telecommunications technologies, such as computerized airline and hotel reservation and credit card authorization systems, frequent travelers' sensitivity to issues of quality and price increases while their tolerance for constraints on greater travel choice and flexibility decreases.(4)

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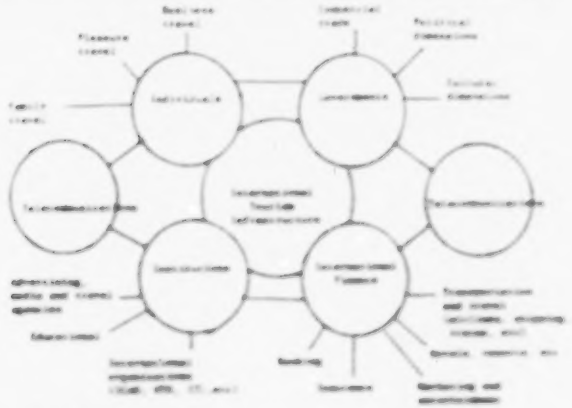
Figure 4 --Integrative Model of Tourism as International Relations



Source: Ronald Hawkins, International Communication Program, School of International Service, The American University, Washington, D.C., July 1990.

Figure 1

2. International Tourism Background

To make clear the dimensions of the international tourism flow encompassing the frequent traveler, following are some stunning statistics [5]. [International tourism as defined by the World Tourism Organization is a trip of a 24-hour sojourn in another country.] International tourism evolved in a climate of expanding world trade and rising production, employment, and income in virtually all industrialized countries.(6) Travel and tourism accounted for nearly $2 trillion in sales in 1987. Total world tourism arrivals in 1988 of approximately 350 million represented a gain of 8.7 percent over 1987 figures. Tourism ranks as the largest industry in the world in terms of employment (101 million people, one of every 16 workers) and ranks in the top two or three industries in almost every country on nearly every measure. In virtually every country, the industry is as large as--and in many countries larger than--the entire agricultural sector or major manufacturers (autos, electronics, steel, textiles) considered integral parts of economic policy. Complex inter-industry interdependence of tourism products and services indicate that each billion dollars in travel sales generate close to $2 billion in aggregate output.

Between 1986 and 1999, international trips (counting all trips across international borders regardless of duration) are predicted to increase from 500 to 910 million with real travel spending (excluding fares) rising from $189 to nearly $288 billion at constant 1985 relative prices and exchange rates.[7] Projected figures for the year 2000 are 731 million in world international tourism arrivals and $386.1 in receipts (excluding international passenger fare payments).[8] Concomitant with the accelerated numbers of international travelers and frequency of travel is the increasing wealth, cross-cultural exposure, and rising expectations of the frequent traveler in market oriented economies.

3. International Business Travel

To compete in today's globalizing tourism infrastructure, therefore, tourism related corporations and institutions have been forced to differentiate their services through the development of innovative programs that reduce reliance on price competition. The full fare frequent business traveler, concentrated in large corporations and in both the service and manufacturing industries, has become the logical target. Although profiles of the frequent business traveler vary, common characteristics include: travel costs are met by an outside source; travel purpose is not discretionary; and transaction value and income is higher than average.(9) In the United States, for example, 20 percent of frequent business travelers live on the East or West coasts and are traveling further and increasingly by plane.[10] In 1986 it is estimated that 17.5 million or 32 percent of adult air passengers were business travelers, 40 percent of all trips were taken for business purposes, and that these trips generated 46 percent ($60 billion) of the industry's $64 billion of passenger revenues.[12] There were an estimated 32 million international passenger arrivals for business or conventions in 1986, representing 14 percent of the estimated total of 221 million arrivals in that year.[13]

4. Frequent Flyer Programs

The development of airline frequent flyer programs in the late 1970s is an example of an effective marketing strategy devised to meet the need "for differentiating airline services and appealing directly to the traveller, who, in many instances, is different from the purchaser of the ticket."(14) It is estimated that roughly 20 to 25 percent of airline traffic in general consists of travelers accruing benefits in airline frequent flyer programs and that 72 percent of business travelers participate in one or more programs, compared with only 23 percent of leisure tourists.(15)

Little known as recently as ten years ago, frequent flyer programs have multiplied internationally throughout the 1980s becoming a well-known, integrative component of contemporary air, land, and sea travel. The Airline Deregulation Act of 1978, created to increase competition, served to consolidate the U.S. airline industry down to five major carriers (American, Continental, Delta, Northwest, and United), and to proliferate frequent flyer incentive programs designed to secure traveler loyalty. The resulting diversity in air travel rules, regulations, and offerings is a confusing specter for today's frequent traveler. "With deregulation, there isn't a simple answer to anything."(16)

In the United States, American Airline's AAdvantage program, initiated in May, 1981, became the industry pace setter for what rapidly became globalized market practices centering around the frequent traveler concept. The original AAdvantage program paid bonuses to American Airline passengers who flew 12,000, 20,000, 30,000, or 50,000 miles on the carrier in one year. These bonuses included, respectively, upgrades from coach to first class, travel discounts from 25 to 50 percent, and free first class round trip tickets to any American destination.(17)

On July 13, 1981, Braniff, in perhaps the first salvo of cut-throat competition, offered credit on its new frequent flyer program to any American Airlines frequent flyer participant willing to switch.(18) Also on July 13, United and Texas announced initiation of their programs, and the race to gain the attention and patronage of the frequent traveler had begun. By July 16, Continental announced its Flightbank program (referred to at one time as Flightbonus) which was to become critically important to the future integration of transnational banking into the international tourism infrastructure. In addition to the more standard air mileage awards toward free travel and increased seating privileges, Continental shortly became the first to offer additional bonus points (with a cash-equivalent between $10 and $20) for travel booked with a Carte Blanche credit card.(19) Although to be among the first and of

credit cards in the travel industry. Continental's program increased the integration of transnational financial institutions into the international tourism infrastructure. This tying of the frequent traveler to a particular mode of travel finance enhanced the complexity and distributive power of the links between individual frequent travelers and the transnational bank and nonbank credit card industry.

By July 27, 1981, with Northwest's program announcement, all the major U.S. airlines were on board with some form of frequent flyer program. By August 24, 1981, Western Airlines had introduced the first "one-card" system in the industry. Western developed the wallet-sized card to provide passengers with credit facilities, automatic membership in its VIB (very important business) frequent flyer club, and entry to its Horizon Club Airport lounges. The card, which included the right to cash personal checks up to $50 at any Western ticket counter, was developed "in direct response to the needs of our frequent travelers who asked for this kind of convenience and extra service."(20)

Within the same period, major domestic and transnational hotel chains, such as Travel Lodge, British Transport Hotels, Hilton International, and Inter-Continental Hotels formalized their frequent guest packages to include discounts on rooms, guaranteed reservations, increased quality of in-room services, executive floors, etc. More important, however, was the establishment by August, 1981, of club cards, such as the British Transport Hotel's Night and Day Card, and the increasing recognition of the need for hotel business facilities with electronic document transmission capabilities.

Subsector linkages among airline frequent flyer and hotel frequent guest programs with reduced-rate car rental incentives fostered rental industry majors such as Hertz and Alamo to come up with frequent user programs of their own.(21) Made possible primarily through innovations in computer technologies, these links, in turn, triggered increasingly complex economic and information based interdependence throughout the tourism infrastructure.(22)

Of particular interest to this study are the distributive breadth and complexity achieved by these programs in less than a decade through the application of communication technologies. There is an increasingly noticeable tone in the contemporary travel literature that the base of frequent traveler programs, viewed here as an information communication process, has become overly distributed. Profitability and effectiveness are at stake. The U.S. airline, hotel, and car rental sponsors of frequent flyer and frequent guest programs, recently are coming under pressure -- fostered by globalization, increasing expenses, and tighter controls -- to curtail or transform their frequent traveler programs into more closely targeted marketing. Ironically, what is operating, both the capability as well as the necessity for such a transformation is the greater use of sophisticated tracking systems and computer data bases essential to the targeting of actual users of frequent traveler programs. "The international market is 'the new frontier' of the frequent user programs."(23)

5. American Airlines AAdvantage Program

Recent changes at American Airlines, historically an aviation industry innovator, is a good example of transnational airline response to contemporary pressures on industry approaches to the frequent traveler and frequent flyer programs. Rather than curtailing operations, American is enacting a plan for services improvements based on 18 months of research and development. In April, 1990, American announced plans for an $11 billion investment over the next five years "to expand its service so that it can compete effectively with foreign flag carriers." Investments included $7.7 billion on 34 MD-11s, Boeing 767-300s, and Airbus A300 for international transit, $655 million in terminal expansion at international airports and U.S. gateway cities (including high-tech baggage systems, more and expanded Admirals Clubs, improved check-in and screening facilities), and $3.4 billion on improvement of services in general.(24) American's focus is on improving first- and business-class travel(25) through introduction of its new "International Flagship Service." With its newly acquired Latin American routes, American will be offering 145 trans-Atlantic flights a week.(26)

Comparable to the U.S., and conceivably transnational, travel industry at large, American is faced with overextension in the distribution of its frequent flyer programs. Its frequent flyer club, AAdvantage, begun in 1981, had two million members by 1984 and 11 million by 1990.(27) Without owning Sabre, its own computerized reservation system, American would be swamped with information overload in tracking the universalizing communication base of its own frequent traveler "family." This is not to mention the additional, enormous transactional information flows through Sabre CRS of international tourists not aligned with its programs. As it is, it is estimated that American carries the potential liability of close to 70 billion unused miles accumulated by its frequent flyers on its balance sheets. This backlog has swelled substantially since the triple mileage awards started by Delta in 1988, which were matched, through force of competition, by airlines throughout the industry.

American borrowed a 1970s frequent guest technique from the transnational hotel industry to become the first airline to offer a new airline package swapping frequent flyer miles for tangible, often luxury goods and commodities. It marketed these through a 32-page color catalog.(28) American pays virtually nothing for these items to the 20 plus advertisers involved who feel adequately recompensed through the value-added distribution exposure they gain from access to American's frequent flyer mailing list, an issue in information privacy all its own. The offerings

range from mink coats and floor clocks to personal computers, player pianos, and financial instruments, and involve negotiating a price and cashing in a set number of miles to get a further rebate.(29) For example, for 20,000 miles, certificates of deposit may be purchased at lower than market prices and higher yields. Caught in its own integrated distribution network, American is vulnerable to one unforeseen circularity in its new promotion. That is the ability of a frequent flyer to reduce the mileage being drained from his or her mileage bank through payment via a credit card linked to American's frequent flyer program, worth on certain credit cards one mile for every dollar spent.(30)

6. Emphasis on the Human Dimension:
Frequent Flyer Clubs

Globalization of travel and its close association with telecommunication technologies, consequently, is demanding greater emphasis on the human dimensions of the international tourism infrastructure, particularly on travel and transportation industry employee education; however, it is the advertising techniques combined with the best American and European promotional know-how that has captured the international market. Staffing of frequent traveler programs now requires cross-cultural as well as managerial knowledge of languages, travel regulations, and currencies. Experienced computer reservation system vendors are crucial elements in the monitoring and tracking of strategic information flows embodied in frequent traveler airline and credit card computerized records. An increasing multiplicity of transnational airline alliances and joint ventures, made viable by telecommunications technology, are changing the very nature of the frequent, international travel experience. For example, on April 9, 1990, Swissair and Delta introduced their European Travel Invention. Based on a so called "modular package concept," the program stresses flexibility and individual selection by clients of various "vacation elements (air, rail, Kemwel rental car, optional tours, and locations throughout Switzerland and Europe) to suit their desires."(31)

In the face of the very telecommunications technologies making such frequent travel programs possible is the increasing recognition of the human dimension within the international tourism industry, of the salability of ambiance or "personalized treatment as a luxury"(32) -- old wine in new bottles. Lounge clubs and loyalty clubs are the primary mechanisms transnational airlines have discovered to personalize their service to the frequent traveler. The club power of appeal is controlled through limiting membership access. Less elite lounge club facilities at airports are accessible for a fee. Loyalty clubs are designed to reward the dedicated frequent traveler and often are open only by invitation to a controlled low enrollment number. "Just how special the treatment is usually depends upon how good a customer you are; you have to earn your way in."(33)

A good example is British Airways, which offers four clubs. Most exclusive is its Premier Club, based on an expenditure of $40,000 or more annually on British Air flights. Club membership, currently at 900 (ceiling of 2,000) is by invitation only. Members receive top priority on everything, a BA Air Plus travel charge card, a personalized toll free reservations number, priority recognition, lounge access with guests at any time, complimentary insurance coverage, and discounts on hotels and car rentals.(34) Australian Airlines Flight Deck Club, on the other hand, costs approximately $150 to join, with an annual $200 fee. Among many privileges, club benefits are globally distributive through reciprocal club use agreements with Northwest Airlines World Clubs, British Airways Executive Clubs, Air New Zealand Koru Clubs, Cathay Pacific Marco Polo Clubs, Canadian Airlines International Empress Clubs, and United Airlines Red Carpet Clubs.

Foreign carriers have been slower than their U.S. counterparts to integrate frequent traveler programs into their operations. This is due partly to their lower starting position in 1980 in computer reservation systems technology -- virtually prerequisite for the movement and management of multi-faceted frequent flyer travel arrangements, mileage awards, and other benefits. Also, until recently, it mainly has been only their U.S. and Canadian passengers who expected such luxury services.(35) By 1990, however, the worldwide distribution of foreign airline club privileges reflected the diffusion of American transnational marketing techniques which in turn were made possible by global expansion of American computer technologies, such as airline CRS. This has contributed to furthering the links between transnational carriers through the international tourism infrastructure. For example, in addition to its own frequent flyer program for corporations, Lufthansa has partnerships with Delta, Eastern(36) and Continental, United, and USAir. Similarly, Japan Airlines has offered is own program since 1983 but is also a member of the Delta Frequent Flyer plan.

Frequent Traveler Programs and
International Relations

The relationship of frequent traveler programs and telecommunications technologies comes quickly to the level of international relations policy when power and national sovereignty are at stake. From an international relations perspective, the frequent traveler, especially frequent flyer, phenomenon suggests convergences taking place in power and control of the tourism distribution process. The effect on business travel by U.S. Department of State travel advisories for certain regions of the world during the Persian Gulf War is one example of this influence. Financial and technological incentives as well as disincentives, in other words, now may tend to favor those nation states served by transnational technological and financial networks as well as air carrier suppliers and advertising techniques. An understanding, then, of who is benefitting and

who is leading increasingly may become a function of who is controlling access to the economic resources, ownership, production, and, most critically, the distribution of transnational information and human flow in the frequent traveler process.

In today's global economy, instruments such as communication, organizational and advertising skills, and manipulation of travel markets have become important sources of power. Thus, countries, such as the United States, Germany, and Japan, which foster transnational firms are becoming more powerful in the international scene. Added to this, American and European long-time experience in market and advertising techniques are becoming crucial elements in intangible sources of power.

The diversity and complexity of participants involved in the tourism consumer category of the tourism infrastructure as international relations model provides a useful framework for examining national sovereignty, a concept of paramount importance in international relations. Through tourism, a plethora of actors other than nation states participates directly in world politics. The transnationalization of airlines through joint marketing agreements centering around the frequent traveler is a good example. The concept of the frequent traveler, and especially the frequent flyer, is primarily an invention of the U.S. travel, particularly airline, industry within the last decade. Viewed in this study as part of an information communication process, links among airline, hotel, and car rental frequent user programs have grown in distributive power and complexity throughout the 1980s.

The rapid adoption of frequent flyer programs and club privileges by foreign airlines shows the diffusion of American marketing techniques throughout the international system. Not only American technologies but also American advertising and marketing strategies are expanding globally establishing supernational relationships through travel agreements among transnational air carriers. The increasing level and geographic distribution of such international interactions are contributing to the erosion of the conditions upon which traditional conceptions of national sovereignty are based. It is not that the importance of nation states as coherent units and dominant participants in world politics is disappearing. Rather, it is that the conditions underlying contemporary interactions are changing, shifting the political processes at times away from traditional definitions in the direction of linkage strategies and agenda setting characterizing new transnational and transgovernmental relations.(37)

The complexity and integrative nature of the tourism infrastructure in the area of transnational air carriers illustrates this well.(38) Bilateral and multilateral economic and trade relationships among transnational air carriers, including CRS agreements and financial networks, are expanding. This connectivity has important implications for traditional concepts of national sovereignty and power through ownership and control of electronic distribution of capital and information. Participants other than nation states, such as American Express, virtually every transnational airline, AT&T, Electronic Data Services, Citicorp, etc., are emerging as major participants. This is opening the way for an increasing supernational role for international organizations and transnational corporations in the political processes surrounding transgovernmental relations.(39) As the products, markets, physical plants, research facilities, and ownership of major corporations go global, the concept of clear national identities is diluted.(40)

The transnationalization of United Airlines and American Airlines frequent flyer programs is a good example. In 1984, United Airline's Mileage Plus program served 153 cities and boasted two million members. Members of this frequent flyer group who journeyed 350,000 miles or more on the airline were entitled to a 24-day South Pacific cruise for two. Since 72 percent of business travelers today participate in one or more frequent flyer programs, the time consuming nature of this award may well have been difficult for the high mileage, constantly traveling business awardees to redeem. In response, American Airlines -- burdened (as were United and many others) with the accumulated accounting liability of millions of unclaimed frequent flyer free miles -- by the end of the decade initiated its mink-coat-for-miles, commodities-based travel loyalty award program. The concept of diversification and diffusion of ownership and control of frequent traveler program agreements and incentives was imitated by other U.S. and foreign air carriers.

The most recent offering of American's AAdvantage Program is a "Dial For Miles" joint marketing agreement with MCI, announced February 26, 1991. In this unique integration of telecommunications and travel networks, of electronic information flow and physical flow of people, MCI and American Airlines offered five AAdvantage miles for every dollar spent on MCI residential long distance calling. The service applied to calls everywhere in the U.S. and to over 180 countries and places worldwide, with a 500 AAdvantage mile bonus just for signing up. A personal MCI/AAdvantage charge card for credit calls issued to subscribers linked the program to back office financial networks which kept track of both minutes and miles. In an effort both to expand business and universalize its telecommunications base, MCI tapped into American Airlines transnational frequent traveler network, linking international communication with international tourism. Electronic capital flows and credit and information data bases, thereby, become shared resources making economies of scale in travel, telecommunications, and financial services more accessible.

Similar joint ventures, marketing agreements, and consolidations between major transnational organizations in the area of telecommunications, transnational finance, and transportation further illustrate the changing nature of power,

information, and capital in international relations. United Airlines, for example, as early as 1984 had established transnational frequent flyer and joint marketing agreement tie-ins with Air France, Air New Zealand, Lufthansa, and SAS, plus U.S. domestic links with Hertz, Budget Rent A Car, Westin Hotels, Royal Viking Line, Braniff, and seven regional airlines. United Airlines, therefore, for 150,000 miles in 1984 was able to offer its program members two round-trip first class tickets to Hong Kong or Tokyo on United, two round-trip coach tickets on Air New Zealand, one round-trip first class ticket on Lufthansa or two round-trip first class tickets on Air France.(41) In so doing, United Airlines' frequent traveler program, not illogically, linked frequent travelers with a selection of largely industrialized travel destinations. A more recent example was in February, 1991, during the peak of the Persian Gulf crisis when United Airlines offered free round-trip tickets to travelers subscribing to its new nonstop Chicago-Tokyo route. These tickets, rather than free to anywhere, were restricted to travel within the U.S., Mexico, and the European Community.

In conclusion, through technological and financial convergences taking place in international tourism, major transnational travel, telecommunications, and financial corporations are gaining the ability to control the flow of large numbers of tourism consumers and, consequently, millions of dollars in travel-generated revenues. From the perspective of national sovereignty and economic power, the direction of this flow is of critical concern. In this light, the distributive nature of airline frequent traveler programs illustrates the role of telecommunications in the tourism infrastructure and its increasing influence on the process of globalization.

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The Future of Telecommunications and The Travel Industry: The Case of Hawaii 1991-2006

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1. ABSTRACT

The relationship between telecommunications and travel and its ramifications has increasingly become an important topic of inquiry. This paper first provides a brief overview of this relationship. Next, it discusses the results of a fifteen-year forecast on future directions of telecommunications and travel in the State of Hawaii between 1991 and 2006.

2.1 BASIS OF THE STUDY

In recent years, there has been increasing interest in studying the relationship between telecommunications and the travel industry. Commonly addressed as "Triple T" [Telecommunications, Tourism and Transportation], this area of research attempts to examine the implications of these three sectors on society from an integrative perspective.

The Hawaiian Islands are well known for their world-class hospitality industry. With such fame comes the heavy reliance of the Aloha State on its travel industry for socio-economic prosperity, such as contribution to the Gross State Product, generation of employment opportunities and stimulation of economic activities. Because of the great importance of its visitor industry, Hawaii serves as an exemplary case to study the relationship between telecommunications and travel in the existing information era.

2.2 OBJECTIVES

The first objective of this paper is to provide a brief overview of the relationship between telecommunications and travel. In doing so, the role of telecommunications in travel and the changes brought about in the latter will be briefly discussed in Sections 3.1 and 3.2.

The second objective is to assess the future of telecommunications and travel in the State of Hawaii from 1991 to 2006. Using the Delphi Technique, which is introduced in Section 4, the results of the study are summarized in Section 5. This paper then closes with the limitations and conclusion sections.

3.1 TELECOMMUNICATIONS APPLICATIONS IN TRAVEL

Approximately US$ 2 trillion is spent each year on the travel industry throughout the world, which accounts for 23% of global GNP (Miskin, 1990). At present, the travel industry is the biggest source of demand for sophisticated telematics. Information systems have become a strategic competitive advantage to the travel industry (Doll, 1989). In turn, flight information made available through such information systems assumes the role of a strategic competitive factor.

3.1.1 COMPUTERIZED RESERVATION SYSTEMS

The most commonly known form of telecommunications applications in the hospitality industry is that of computerized reservation systems [CRSs]. In 1987, American Airlines made roughly 10,000 fare adjustments per day (Aquino and Cruz, 1990). The month of October 1986 alone saw 4 million such fare adjustments! Furthermore, it is not uncommon to find that no two seats on a flight are sold at the same price. Such fare manipulation is virtually impossible to accomplish manually, thus making it easier to comprehend the heavy reliance of the airline industry on CRSs. In addition to keeping track of sales and seat allocations, CRSs are proving to be major profit generators as well. By keeping low-fare seats to a bare minimum to fill the planes, the rest are sold at a profit.

Today, CRSs have also been widely adopted by lodging businesses. Furthermore, rental car companies, such as Avis and Budget which issue the Wizard Card and Rapid Action Card, respectively, to regular clients also utilize automated reservations (Oliver, 1988).

One way in which airlines, hotels and rental car companies can make use of their CRSs to generate revenue is through charging travel agencies and other end-users, such as corporate travel information centers, fees to access their information systems. In addition to such immediate gain, long-term insurance of profit comes from loyalty to the information system (Bailey, 1989): whichever carrier can get its CRS most widely adopted will have a higher chance of getting more bookings than other competing airlines, and in turn, more sales.

3.1.2 OTHER APPLICATIONS OF INFORMATION SYSTEMS, TECHNOLOGIES AND NETWORKS IN THE TRAVEL INDUSTRY

In addition to facilitating reservations, telecommunications capabilities are also employed in the hotel businesses to enhance hotel operations and guest services. Property management systems [PMSs], as information systems in the hotel industry are commonly known, include the use of such applications as point-of-sale technologies, automated check-in/check-out systems, pay-per-view movies and voice messaging.

The latest feature available in pay-per-view technology is on-demand programming. Viewers no longer have to wait for specific show-times, but can enjoy any movie at any time of the day they desire.

With respect to the telephone system, automated voice mail features are gradually being implemented. This is particularly valuable in solving the language problems with calls for hotel patrons who are from overseas. Other features, such as call accounting and call transmission will also be experiencing continual upgrades.

Furthermore, telecommunications applications are gradually being adopted in back-of-house support systems, such as in monitoring electricity and security/surveillance. A recent innovation in electronic security in hotels is that of the extension of guest-room card keys to on-line security.

ISDN. Information transfer of large volumes and diverse nature is a critical component of the hospitality businesses (Portugal, 1991). Because of such information needs, ISDN, which incorporates voice, image and data, will be a suitable application to the travel industry.

Videotex. Videotex is a system that is a promising candidate for offering up-to-date on-line travel information. An example is the French videotex system, Minitel, which proves to be most successful in its services dedicated to travel. Potential travellers can conveniently pick their destination, arrange for their travel and accommodation (Rouet, 1991). Other success stories in videotex travel information services are offered by Australia's Aftel and the Republic of China's Chinese Videotex System [CVS].

VSATs. Very small aperture terminals form the information systems backbone of some hotel chains, such as Holiday Inn. These satellite dishes provide low-cost one-way, receive-only communication and two-way transmission of video, voice and facsimile by time-sharing or frequency-sharing.

Telecommunications Hubbing. Hubbing provides cost and operational efficiency and flexibility in telecommunications networking for travel information to be transmitted among different points of the network. SITA is a perfect example. With more than 750 centers and access nodes, the SITA network relies on the hubbing concept to provide information and telecommunications services to 400 airlines and associated industry members in 184 countries in the world (Crawford, 1991).

Automated Ticketing Services For Travel Agencies. Among few new network services available to travel agencies are satellite ticket printers [STP] and electronic ticket delivery networks [ETDN], which both automate ticketing (Darby, 1991). The STP vendors get part of the commission of travel agents for ticket printing, while ETDN vendors charge a flat rate.

3.2 IMPACTS OF CRSS AND OTHER TRAVEL INFORMATION TECHNOLOGIES, SYSTEMS AND NETWORKS

Having seen several types of telecommunications applications in travel, this section discusses some changes brought about in the hospitality industry.

3.2.1 ALLIANCES AND MERGERS

After deregulation of the airline industry in the United States, coupled with the transition of the industry to becoming heavily reliant on information systems, smaller regional US airlines were not able to compete. Consequently, they either formed alliances with larger carriers, merged with other small airlines, or sold out (McGee & Burdick, 1986). Even the mega-carriers themselves have been trying to take advantage of alliances with each other.

At the international level, carriers ally with each other to expand their operations. For instance, in 1987, British Airways and United Airlines made an agreement to integrate their networks and flight schedules (Cotter, 1988). The alliance also includes code sharing, where the allied commuter airline's services are recorded under the host airline's two-letter reservation code in its CRS (Oster & Pickrell, 1986).

In addition to "inter-airline" cooperative efforts, telecommunications firms have also been sought to provide technical contribution to join force with management and business skills in the travel industry. In 1990, for example, Electronic Data Systems [EDS] acquired half of Texas Air's CRS for $250 million. This is in addition to $4 billion worth of anticipated contracts over the next ten years (Reier, 1990).

Another type of strategic cooperation common to the travel industry is that of horizontal alliances, where an airline, a hotel and a rental car company agree to cooperate in their information systems, marketing efforts and other joint endeavors. Examples are the alliance among American Airlines, Sheraton Corp. and Avis Inc., as well as the partnership of United Airlines, Westin Hotels and Resorts, Hertz Corp. and Covia Corp in their multinational CRS called Allegis (Agnew, 1987).

3.2.2. DISINTERMEDIATION

Disintermediation entails the concept of eliminating the "middle man" between the producer and/or wholesaler of a product or service and the consumers, with transactions made directly between the seller and the buyer. In the context of tourism and transportation, the "middle men" are the travel agencies and brokers.

Direct access to information and reservation systems presents potential threat to these intermediaries. At present, with the use of a computer and a modem, one can access on-line travel information networks and arrange for one's own bookings. An example is the electronic edition of the Official Airlines Guide [OAG/EE] which, in addition to enabling travellers to make instantaneous reservations, provides most up-to-date flight information and permits search for the cheapest fare (Levitan, 1988). Compuserve is another system that offers a wide range of information on travelling.

There exists the argument that rather than being threatened by the availability of CRSs and other travel information networks, travel agents will actually benefit from these technologies by having their workload in information gathering, bookings and confirmation reduced considerably and made more efficient. The key is to be able to implement a strong information-systems base in their offices to access the industry's travel information.

4. THE DELPHI TECHNIQUE

The Delphi Technique is employed to achieve the second objective of this paper: to develop a fifteen-year forecast on the future of telecommunications and the travel industry in the State of Hawaii from 1991 to 2006.

Delphi is a systematic approach that utilizes expert opinion to deal with complex problems (Wedemeyer, 1985). It is a valuable tool to both forecasting and structuring group communication. Furthermore, this method is especially useful during the early stages of planning, such as scenario development or goal setting.

Normally, a Delphi study consists of two-to-three rounds of questions about the topic under study. The process of administering the study is characterized by (1) structuring information flow, (2) feedback to participants, and (3) anonymity for the participants (Linstone, 1978).

5.1 THE DELPHI STUDY

For this study, two rounds of 49 questions on highly possible and significant future developments in Hawaii's telecommunications and travel industries were mailed to 105 experts selected from local industry, government and academia. 51 responded to the first round and 32 to the second.

Out of the 49 questions, 31 are trends, which depict changes in developments overtime [growth, retardation, etc.]. They fall into five groups:

- o General Trends
- o Technical Trends
- o Economic Trends
- o Market Trends
- o Social Trends

The remaining 18 questions are events, which represent sudden changes [policy intervention, emergence of new services, etc.]. They are categorized as:

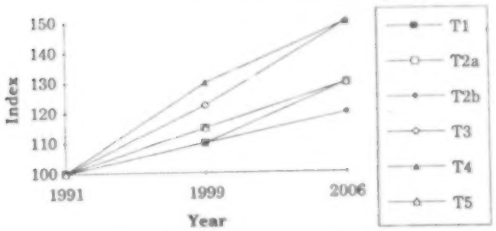
- o Systems/Services Events
- o Regulatory Events
- o Socio-economic Event

5.1.1 GENERAL TRENDS [T1 to T5]

The general trends are formulated to draw expert opinions on the overall

macro-outlook of where telecommunications and travel are heading in the coming fifteen years. In sum, the view of the expert participants is a conservative one; they do not see much dramatic growth or changes [see Figure 5.1.].

Figure 5.1. General Trends



T1 = overall quality of telecommunications systems
T2a = increased efficiency of operations with use of info. tech.
T2b = improved quality of guest services with use of info. tech.
T3 = visitors' demand for telecommunications services
T4 = availability of travel info. via electronic delivery
T5 = info. systems as competitive technological advantage to travel

5.1.2 TECHNICAL TRENDS [T6 to T13]

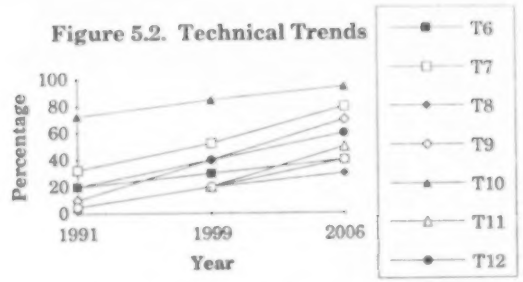
All of the technical trend questions, with the exception of T13 [advertising of travel through digital interactive multimedia channels], relate to the information systems infrastructure in the hotel industry. This is an attempt to assess the extent to which telecommunications technologies have been, and will be, applied to facilitate the everyday operations of hotels and resorts in the State of Hawaii. Figure 5.2 presents a profile of these seven hotel information systems trends.

5.1.3 ECONOMIC TRENDS [T14 to T15]

In order to gauge how dependent Hawaii's economy is on its travel industry over the coming fifteen 15 years, T14--visitor expenditure as percentage of total annual GSP--was included in the questionnaire. According to the estimates given by the expert panel, 48% and 50% of Hawaii's GSP by 1999 and 2006, respectively, will be generated directly and indirectly by the travel industry.

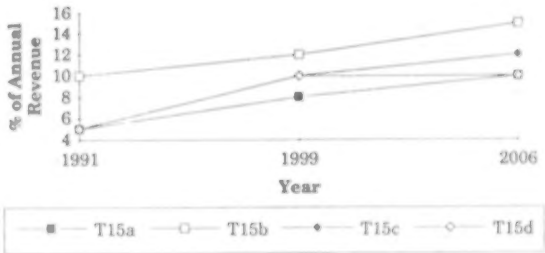
T15a to d ask for expert projections on the investment levels in information systems in the travel industry as a whole and the different segments, i.e., airlines, hotels and travel intermediaries. The results are shown in Figure 5.3.

Figure 5.2. Technical Trends



T6 = % hotels/resorts with convention/conference centers
T7 = % hotels/resorts with automated check-in/check-out systems
T8 = % hotels/resorts with in-house teleconferencing facilities
T9 = % hotels/resorts with automated voice mail/messaging services
T10 = % hotels/resorts with pay-per-view programs
T11 = % hotels/resorts with additional phone jacks in guest rooms
T12 = % hotels/resorts with electronic back of house support systems
T13 = % marketing of travel through electronic multimedia

Figure 5.3. Investment in Information Systems



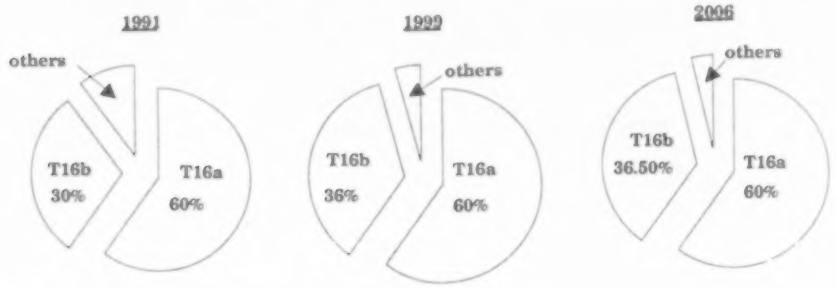
T15 = Investment in info. systems as % total annual revenue of
a = the entire travel industry
b = the airline industry alone
c = the hotel industry alone
d = travel intermediaries

5.1.4 MARKET TRENDS [T16 to T20]

In order to assess the level of disintermediation, if any, that will likely take place in the state's travel industry, T16a and b were formulated [see Figure 5.4]. A possible interpretation of the projections is that additional sales resulting from an expanding market will tend to be captured by the airlines and hotels themselves.

Regarding the size of the state budget for travel being spent on advertising and marketing [T17], it is estimated to remain unchanged between 1991 and 1999,

Figure 5.4. Distribution of Market Shares in Total Annual Sales in Travel

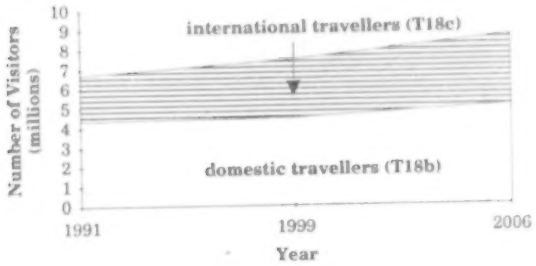


T16a = % total annual sales in travel made through travel intermediaries
T16b = % total annual sales in travel made directly between travel services producers and customers

i.e., at 25%, while increasing to 28% by 2006.

The rest of the market trend questions are intended to estimate the total annual number of visitors to the Aloha State between now and 2006 [T18a], the ratio of domestic to international travellers [T18b:T18c], percent of T18a being business travellers, and in-bound business trips that can be substitutable by teleconferencing. [See Figures 5.5 and 5.6.]

Figure 5.5. Total Annual Visitors (T18a)

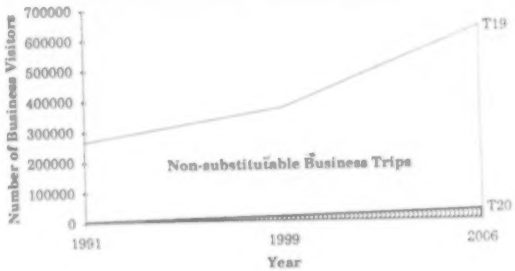


The percentage of visitors to Hawaii being domestic travellers will decrease from 65% at present to 60% by 1999 through 2006, while there will be a parallel increase in international arrivals.

5.1.5 SOCIAL TRENDS [T21 to T24]

The four social trends are intended to draw the employment profile of Hawaii's travel industry between 1991 and 2006. Figure 5.7 shows the percent of Hawaii's work force directly employed by the travel industry [T21] and the percent of travel personnel with knowledge of at least one more language other than English [T22].

Figure 5.6. Business Trips to Hawaii: Substitutable and Non-substitutable



T19 = % visitors being business travellers
T20 = % in-bound business trips substitutable by teleconferencing

According to the projections for T23, 8% of the travel industry employees will be telecommunications/information systems workers by 1999, and the figure will increase to 11% by 2006. Furthermore, by 1999 and 2006, 4% and 5% of these travel information systems personnel, respectively, will be teleworking from home or a remote telework center.

Figure 5.7. Direct Employment in Travel

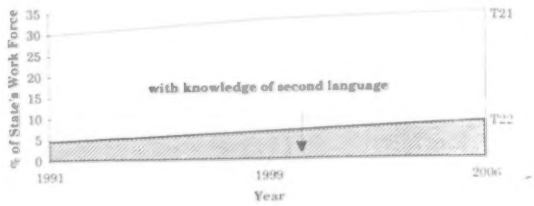


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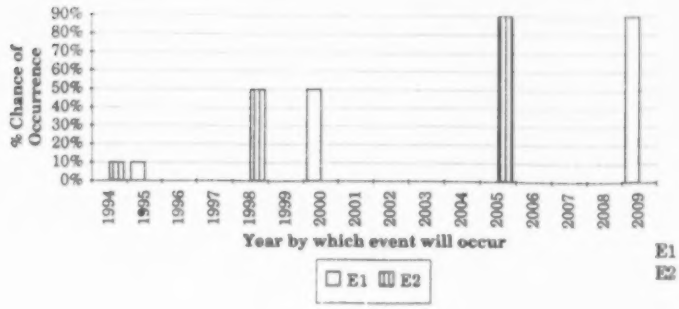
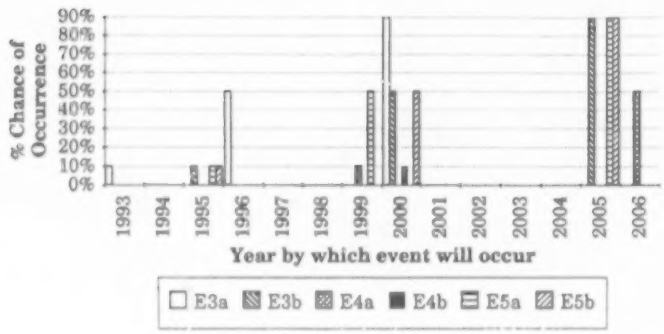
Figure 5.8. New Systems for Travel Information



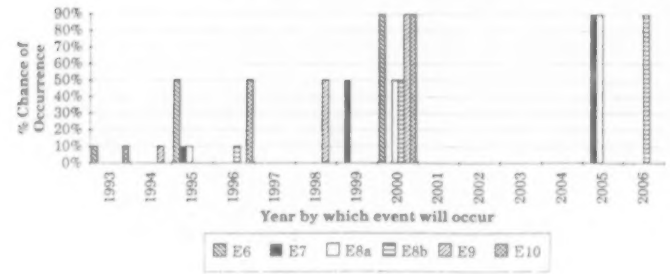
E1 = on-going use of broadband ISDN in travel
E2 = on-going videotex tourist info. system in major tourist sites

Figure 5.9. New Features in the Phone System



E3a = int'l prepaid card phones in major tourist sites
E3b = int'l prepaid card phone throughout state
E4a = language translation in the phone system in major tourist sites
E4b = language translation in the phone system throughout state
E5a = payphones for speech- and hearing-impaired in major tourist sites
E5b = payphones for speech- and hearing-impaired throughout state

Figure 5.10. Automation in Travel



E6 = inter-island flight schedules available on cable TV
E7 = automated reservations/bookings of inter-island tours
E8a = fully-automated ticketing in major tourist sites
E8b = fully-automated ticketing throughout state
E9 = request/order of hotel services by videotex
E10 = guest message handling by videotex in major hotels

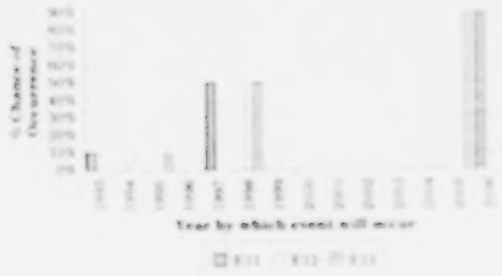
5.1.6 SYSTEMS/SERVICES EVENTS [E1 to E10]

These event questions provide estimates on: [1] new systems for travel information; [2] new features in the phone system; and [3] automation in travel, as shown in Figure 5.8, 5.9 and 5.10.

5.1.7 REGULATORY EVENTS [E11 to E13]

The first regulatory event, E11, relates to the controversial issue of shared tenant services [STS] being approved, allowing hotel/condominium owners to by-pass the local phone company in offering their own telecommunications services to patrons [see Figure 5.11]. E12 is a projection on the chances of a bill granting tax credits for teleworking [E12] being passed by the State Legislature. The last regulatory event question asked is GTE Hawaiian Tel being allowed to enter the entertainment industry in offering video switching services [E13].

Figure 5.11 Regulatory Events



5.1.8 SOCIO-ECONOMIC EVENT [E14]

This event considers an economic catastrophe scenario, such as a recession, an international or a regional political crisis, with an impact on Hawaii's travel industry that is at least as sizeable as that of the Middle-East crisis in 1991. It is highly agreed that such an event has a 50% chance of occurring as early as within the coming four years, and a 90% chance of happening by 2000.

5.2 TELECOMMUNICATIONS AND TRAVEL: HAWAII 1991-2006

Based on the projections of the developments presented in 5.1 and their ramifications, a number of important conclusions regarding the future directions of telecommunications and travel in the State of Hawaii between 1991 and 2006 can be drawn. These conclusions are listed as follows under three categories: [1] Telecommunications Needs and Usage; [2] Investment in Information Systems; and [3] Travel and Hawaii's Economy. Placed in parenthesis after each concluding point is/are the specific trend[s] and/or event[s] based on which the conclusion is drawn.

5.2.1 TELECOMMUNICATIONS NEEDS AND USAGE

- Overall quality of information systems and applications to travel in the State of Hawaii will advance at a very slow pace between 1991 and 2006. [T1-T5]

- Information technologies are projected to be able to more effectively enhance operational activities, such as reservations and billing, than to improve the quality of services, the human end of the hospitality industry. [T2a and b]

- There will be a slight over-supply of electronic communication services in the travel industry between 1991 and 1999, suggesting that such services will not be readily absorbed by intended users, i.e., visitors to Hawaii, especially business travellers. [T1 and T4]

- By 1999, out of an estimated total of 375,000 business trips to the State of Hawaii, 15,000 will be substitutable by teleconferencing, and 31,900 out of 418,000 by the year 2006. However, owing to the presence of incentive travel, there is uncertainty as to the number of these trips that will actually be substituted. [T20]

- The increase in international visitors suggests growing demand for special telecommunications services/features, such as long-distance calling and language translation. [T9, T18a and b, E3 and E4]

- By 1999 and 2006, respectively, 8% and 11% of those who are directly employed by the travel industry, the latter of whom will constitute about one-third of Hawaii's work force, will be working in telecommunications/information systems divisions/departments. [T23]

- By 1999, out of every 1000 travel information systems workers, 40 will be teleworkers, and the number will increase to 50 out of 1000 by 2006. [T24]

- With availability of in-house conference centers and teleconferencing facilities, the hotel industry can expand its ability to attract and serve business patrons instead of just relying on vacationers for income. This will especially be valuable during off-seasons of tourism. [T6 and T8]

5.2.2 INVESTMENT IN INFORMATION SYSTEMS

- Investment in information systems as a percentage of the total annual revenue of the entire travel industry will double between 1991 and 2006. [T15a]

- The airline industry will be the leading segment of the travel industry in investing the highest percent of its total annual revenue in information systems. It will be increasing its investment in

information systems by 50% between 1991 and 2006. [T15b, E6, E7 and E8]

- The hotel industry will be the leading travel segment in increasing its investment in information systems as a percentage of its total annual revenue between 1991 and 2006, such investment will increase by 120%. [T15c, T16 to T12, E9 and E10]

- Investment in information systems as a percentage of the total annual revenue of the travel intermediaries will double between 1991 and 2006. [T15d]

5.2.3 TRAVEL AND HAWAII'S ECONOMY

- The state of Hawaii's economy will still be very dependent on tourism in the coming fifteen years. [T16]

- The travel industry in Hawaii will be accountable for approximately half of the annual Gross State Product (GSP), while directly employing about one-third of the state's work force. [T16 and T21]

- An additional total of 800,000 tourists to the state between the years of 1991 and 1999 will be accountable for the increase in visitor expenditure as a percentage of total annual GSP from 47% in 1991 to 48% by 1999. The latter will accelerate to 50% by 2006 with another one million visitors arriving between 1999 and 2006. [T16 and T18a]

- Some degree of disintermediation will take place. Although the market share for travel intermediaries will still be relatively secure over the coming fifteen years, additional sales as a result of an expanding travel market will tend to be captured by airlines and hotels themselves. [T16a and b and E6 to E8]

- The highly probable occurrence of an economic catastrophe by the year 2000 suggests the need for some contingency planning for diversifying the Hawaiian economy, which is heavily dependent on visitors for revenue. [E16]

6.1 LIMITATIONS

The main source of limitations in this study relates to the fundamental problem of developing a reliable forecast on telecommunications and travel in the State of Hawaii between 1991 and 2006. Although the results of the Delphi study presented appears solid, the data collected pertain to the future, and as such, are of a "soft" nature. Hence, the interpreted results are mainly suggestive, and should not be treated as more reliable than they actually are.

Another limitation in this study regards a characteristic of the Delphi Technique employed, i.e., the requirement of expertise. Only two out of the 12 final respondents for this study rate themselves as travel experts, and the ten who can be considered experts in both telecommunications and travel are still relatively more confident in rating themselves highly in telecommunications than travel. Consequently, the travel-side data in the forecast are considerably weaker and less reliable than those on telecommunications trends and events.

6.2 CONCLUSION

In sum, despite the presence of limitations inherent in the Delphi Technique, the value of the forecast on telecommunications and travel in Hawaii developed in this study should not be underplayed. It serves to identify potential opportunities, as well as possible disasters and threats, and thus, can be highly useful reference for future policy making and goal setting. A note of caution to bear in mind is that the forecast is only intended to shed some light on a number of highly possible future developments, and that readers should not be overly confident of the data and results presented.

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SOUTH OF THE BORDER, DOWN MEXICO WAY

Ronald W. Symes

Southwestern Bell International Development

St. Louis, Missouri USA

To paraphrase the song, "South of the border, down Mexico way, we met a company and country in which to stay".

Southwestern Bell Corporation has been extremely pleased with its decision to participate in the privatization of Teléfonos de México (Telmex). What I intend to share with you today are some of the experiences leading to our consortium ultimately being chosen by the Mexican government to purchase a controlling interest in Telmex. In addition, I will report on operations to date, what we hope to accomplish in the near term and what has gone "right" and what some of our problems have been.

Of course, as I'm sure you know, we are members of a consortium that was chosen for this purchase; we didn't do it alone. The consortium is made up of Grupo Carso, a large Mexican conglomerate, France Cable et Radio, a subsidiary of France Telecom, and Southwestern Bell International Holdings Corporation, a subsidiary of Southwestern Bell Corporation.

Before I get into the main part of this report, I think it would be appropriate to have some understanding of Telmex in terms of its size, financial results, service quality, and so forth. By way of comparison, Telmex had 4.7 million access lines at the time the transaction was completed in December of 1990. This for a population of some 80 + million people. In contrast, SWBT had 12 million access lines serving an area with approximately 25 million people. Said another way, Telmex had one line for every 15 people while SWBT had one line for every 2 people. Telmex had $3.0 billion in sales in 1990; Southwestern Bell Telephone Company (SWBT) had $7.5 billion. On any given day during 1990 there were over one million held orders for telephone service in Mexico; SWBT had virtually none. Telmex currently has 49,000 employees while SWBT has 56,000.

With this brief introduction out of the way, lets now move to the deal itself.

Based on our experience, there are two key events that must occur in privatization of Telecoms in order for a successful transaction to take place. These events must take place on each side of the negotiating table.

The event that must occur for any potential buyer to participate successfully in a transaction the size of this one sounds very basic; but in our own experience, I can tell you it is not as simple as it sounds. That event is the decision by the senior management of the corporation to fully commit the resources of that company to the project at hand. That sounds, as I said, quite simple. Senior management, by the way, includes the Chairman and Chief Executive Officer. Happily for our company, that decision was made by Mr. Ed. Whitacre early on in the time schedule that Mexico established for their privatization. What this meant to me, as SBC's man in the trenches, was that I could proceed with doing the job without having to seek approval at every step and without having to "sell" concepts at every turn.

The other event that must occur is for the selling entity to make certain decisions as well. In the case of the Mexican government, this meant deciding what their real goals were for their communications network (aside from receiving the best price).

For example, was it their desire to establish an immediate "free market" environment in Mexico for the telecommunications industry; was it to assure themselves that they would have a "world class" communications infrastructure in the near future; was it primarily a series of social goals; or was it some other goal? Fortunately for all the bidders, the government had a clear vision of its goals. Simply stated, the government believed that the Mexican economy could not grow as it desired without a "world class" communications infrastructure.

Indeed, it is my opinion (not an original thought) that no country's economy can grow beyond a certain point without such an infrastructure. Therefore, the government set goals for the privatized Telmex in terms of required growth rates, service levels, etc. and allowed for no direct competition for a period of time so that all efforts of the purchasing entity could be directed entirely toward meeting those goals. This factor also had an effect on the value that potential purchasers would place on Telmex.

Once these important activities have been accomplished, other ongoing actions had to happen so that both parties to the transaction give and receive necessary information vital to the deal.

One of the most important steps that the Mexican government took, which influenced our ongoing interest in the company, was to allow easy access to various governmental departments and agencies so that areas of concern could be readily discussed and issue resolution accomplished. This meant that we, as potential buyers, could discuss items that raised questions which appeared in the concession document and understand items that were not entirely clear to us. This in turn allowed us to better understand why the government had created certain parts of the concession. The exchange of ideas and information in these meetings gave us, as foreigners, a comfort level that would not have otherwise existed. In this same regard, the exchange of information between Telmex management and ourselves was handled in a professional and thorough manner . . . all of which went a long way toward Southwestern Bell feeling good about the deal.

Certainly not to be minimized is the matter of partners in a deal of this size. Any consortium of this type must have partners that are comfortable with each other, respect each other's areas of expertise and, in general, are able to function as one entity. By law, the controlling interest of Telmex had to remain in the hands of Mexicans. Our consortium is very fortunate to have Grupo Carso as that controlling party. Mr. Carlos Slim, president of Grupo Carso, is a businessman who commands the respect of the entire Mexican business community. He has a proven record of turning around businesses that are in trouble and then operating them profitably and efficiently. He is an engineer by training and has had an extremely varied and successful business career before becoming involved in Telmex. He is currently Telmex's Chairman of the Board. France Telecom has a proven reputation for growing and operating one of the most advanced telecommunications networks in the world. These two world class businesses, along with ourselves, proved to be an unbeatable combination in the eyes of the Mexican government. This unbeatable combination also included $1.8 billion. On 20 December 1990 the transaction was finalized.

Next, I will get into what has happened at Telmex since that date and how we are influencing the day-to-day improvements in Telmex.

First a few words about how Southwestern Bell is functioning in Mexico.

+ Southwestern Bell and our consortium partners intend for the day-to-day operations of Telmex to continue being managed by Telmex employees. However, each of the consortium partners is specialized in different areas, serving as advisers and technical experts for Telmex.

+ Southwestern Bell has a core team of 21 employees who have moved to Mexico City to work with Telmex on various key functions. Those include telephone network maintenance, business office procedures, customer service, billing, operator services, procurement, cellular service and directories. Other Southwestern Bell employees are called in as needed to help on specific projects.

+ We are working with Telmex employees on plans for converting older switching offices to digital through a "flashcut", so that customers' phone numbers do not change and their service is interrupted only briefly when an outdated switching office is replaced. The first switching office "flash-cut" will be conducted during the first quarter of 1992.

+ We are assisting Telmex employees in finding and repairing problem areas in switching offices that cause poor transmission on phone calls. There is a lot of trunk blockage between central offices. We've been working on mechanized programs that identify trunk and switching office problems, and we plan to test all cross-bar offices in Mexico City during the next six months.

+ Southwestern Bell people are training Telmex employees in conducting three-way checks to verify that billing, outside plant and central office records are all correct. We've found a 40 percent error rate in the records. Ten percent of the pairs shown to be working are actually vacant and could be assigned. That's 500,000 pairs nationwide.

+ We are assisting Telmex employees in mechanized trouble testing at repair centers and improving repair technician productivity through additional training and supervision.

+ We are showing Telmex how to improve the company's force management and cable management plans. Telmex employees have toured our facilities in Houston to give them an overview of how the Houston network is managed.

+ We have on-site supervisors that are working with Telmex supervisors and employees who are "rehabbing" telephone cables in the Matamoros area. Matamoros has had high trouble report rates, particularly during the rainy season. We're testing products new to Telmex, such as jelly filled cable and new distribution boxes that can withstand environmental problems.

+ We are designing, with Telmex personnel, a new, integrated billing system. Recently, we "captured" all billing complaints from a representative business office. From that, we identified several action items that will improve billing in the short term. In the meantime, we're continuing to work on our long-term project of completely overhauling Telmex's billing system. The integrated billing system will combine permanent customer records with billing information and customers' facility identification records.

+ We have helped Telmex in reorganizing their procurement operations, which are being centralized into one group. The number of warehouses will be reduced from 104 to four and inventory will be reduced from $300 million to $50 million.

+ Our Yellow Pages operations experts are working side by side with Telmex personnel in revamping their Yellow Pages operations. Telmex has implemented a three-year business plan that calls for complete mechanization of the Yellow Pages operation, doubling their sales force, changing work rules and increasing employees' supervision and training. The ultimate goal is of course to significantly increase revenues and profit from this undeveloped part of the business.

+ Our cellular engineering, marketing and operations people are engaged in training Telcel personnel in all phases of this line of business. Engineering has strategically located new cells in Mexico City, in order to improve the quality and capacity of cellular service. Our marketing people have opened many new distribution channels throughout the city and country. In six months, Telcel doubled both the number of cells and number of customers in Mexico City. Similarly impressive results are evident in other locations. Operations people are working to improve the billing system and the interface for billing between Telcel and Telmex.

While I have just mentioned some of the improvements in the cellular subsidiary of Telmex, next, I want to get into specific improvements that have occurred and will occur in the next few years throughout the company. These changes and plans for change have been implemented since 1 January 1991.

+ Telephone service has been expanded to 1,000 villages that didn't have service before.

+ A growing number of Telmex business offices are now issuing service orders with specific due dates (and they are being met). As of 1 November 1991, this included business offices in Puebla, Monterrey and Mixcoac. By 25 November 1991 it included business offices in Hermosillo, Queretaro, Morelia and Veracruz. In December, business offices in Merida, Chihuahua, Guadalajara, Linda Vista and Ermita were brought on line. (By the end of 1992, we hope to have the entire company on due dates.)

+ A growing number of business offices are conducting business by telephone, so that customers don't have to stand in long lines to carry out the simplest business transaction. Also, research is being conducted to determine ways to improve customer satisfaction. In Mexico City, phone contacts at business offices increased from 2 percent to 45 percent in just three months. (By the end of 1992, we plan to have the majority of customer inquiries conducted over the phone.)

Next, I will detail plans for the approaching years to meet governmental objectives and bring Telmex into the "world-class" category of communications networks.

+ Telmex will spend about $2.5 billion per year or $10-12 billion during the next five years to expand and improve its network and services.

+ Access line growth will average 12% per year during the next five years. We plan to reach 7.5 million in 1993 and 16 million in 2000. There are currently 5.4 million lines.

+ During 1991-93:
  * 8,000 rural towns will receive phone service
  * 750,000 access lines will be added.
  * 100,000 public phones will be installed
  * 13,500 kilometer fiber-optic cable backbone will be installed throughout Mexico for long distance service.
  * Digitalization in switching plant will increase from 29 to 60 percent.

+ Central offices serving 500,000 customers in Mexico City will be converted to the latest digital switching technology beginning in early 1992. Our goal is to have 100 percent digital switching in Mexico City by 1995; in Monterrey, Guadalajara and Puebla by 1996; and throughout Mexico by 2000.

+ Telmex will be converting every Telmex operator position to Northern Telecom's TOPS (Traffic Operator Position Systems) switches by the beginning of 1993. Today's 106 operator locations, which all use cordboards, will be converted to 10 state-of-the-art TOPS switches in 33 locations. The first two TOPS switches will be installed in the first quarter, 1992. .mb6.fm2

Under the mechanized TOPS system, Telmex operators will no longer need to manually fill out toll tickets, which have numbered more than eight million per month. Within one or two years after the mechanized toll operator positions are installed, Telmex hopes to begin implementing Directory Assistance.

Finally, a few words about Southwestern Bell's opinion concerning our involvement in Telmex after one year. Are we happy with our investment? We currently own a ten percent equity interest in the company representing an investment of $953 million. As this is being written, less than one year after closing the transaction, that investment is worth approximately $2.1 billion. I'll let you draw your own conclusions concerning our happiness! Would we do it again? ABSOLUTELY!

What has been done since 1 January 1991 is laying the foundation for the more visible improvements to come. To bring Telmex into the "world-class" categories of telecommunications companies will take the five years in the current plans. The people of Mexico expect it and deserve it. It is, therefore, Southwestern Bell's goal, as well as that of our partners, to develop Teléfonos de México into such a world-class telecommunications system, that it will provide a strong foundation for continued economic growth in Mexico.

Ronald W. Symes
Executive Vice President
Southwestern Bell International
Development Corporation

Pacific Rim Telecom Status Report:
Privatization and Competition Strategies in Mexico and the Lands Down Under

"The Promise and the Challenge"

David Frost
Vice President, Bell Atlantic International
Arlington, Virginia

ABSTRACT:

Driven by the need to extend basic service coverage to support economic and social development., countries are not only modernizing their telephone networks but coming to believe that privately-owned telephone companies, not governments, are best positioned to develop and expand the telecommunications infrastructure. Bell Atlantic International Inc., a co-owner of Telecom Corporation of New Zealand, has been consultants, software and systems integrators for leading telephone administrations, partners in cellular consortia and joint ventures for infrastructure development. It is Bell Atlantic International's belief that while privatization and competition offer enormous promise, it can be an unfulfilled future if certain challenges are not met.

The forces that brought about telecommunications deregulation in the United States over the last two decades -- and the dramatic industry restructuring that led to the formation of Bell Atlantic Corporation -- now are creating the same kinds of changes in telecommunications sectors around the world.

Among those forces are: advances in technology; the need for modern telecommunications infrastructures that can support economic growth and strengtrhen a nation's ability to compete in world markets; and the demand for a wide variety of information services.

These information services can range from basic telephone service to assist in broad social and economic development to new, sophisticated services required by multi-national business organizations.

Nowhere are these forces and the resulting changes more evident than in the nations of the Asia Pacific region. Together, they account for nearly one-third of the global population and contain some of the fastest growing economies in the world.

Prompted by the increasing importance to their respective economies of advanced telecommunications systems, Indonesia, Taiwan, South Korea, Singapore, Hong Kong, Malaysia, New Zealand, Australia and Japan together are expected to spend over US$100 billion on telecommunications development in the mid-1990s.

Bell Atlantic's strategy -- to become a leading worldwide provider of telecommunications and information management services -- complements the national telecommunications strategies of many Asia Pacific nations.

Bell Atlantic seeks to achieve this objective by participating in international ventures that capitalize on strengths we have developed in the United States.

Bell Atlantic serves the telecommunications needs of the eastern region of the United States, an area containing nearly 34 million people in 13 million households, along with 845,000 small business customers.

The capital of the United States, Washington, D.C. is situated in the heart of Bell Atlantic's territory. Among the corporation's biggest and most advanced customers are the U.S. Federal Government, including the White House and Congress, as well as the embassies of many nations from around the world.

Bell Atlantic also serves some of the most sophisticated, communications-intensive companies in the United States. The headquarters of 62 of the nation's Fortune 500 Services companies and 80 of the Fortune 500 Industrial companies are located within Bell Atlantic's territory.

The Bell Atlantic telecommunications network is one of the most advanced, well-managed and cost-efficient landline telecommunications systems in the world. Residential, business, government and diplomatic customers rely on a wide range of telecommunications services provided by Bell Atlantic's seven telephone companies, which serve over 17 -and-a-half million telephone access lines.

With the acquisition of Metro Mobile CTS, Inc., Bell Atlantic will be one of the largest cellular telephone carriers in the United States, with nearly a half-million customers.

In addition to providing landline and wireless communications systems, Bell Atlantic also offers state-of-the-art business systems capabilities that help many of its customers extract the maximum financial and operational values from information technology.

Bell Atlantic is parent to several organizations that provide computer services and support, systems integration; expert systems connectivity and network management software; information and communications systems, software and supplies; and a broad range of equipment leasing and financial services in regional and national markets.

Outside the U.S., it is Bell Atlantic International's responsibility to actively market our core telephone business and related skills and technologies.

We also explore investment opportunities that will help us reach our strategic goal of becoming a leading international communications and information management company.

In the process, we've been consultants, software and systems integrators for leading telephone administrations around the world.

We are also partners in several ventures around the world that are modernizing telephone networks, constructing national cellular systems and building public packet-switched data networks.

Bell Atlantic is a member of the consortium that purchased New Zealand's state-owned telephone company. Valued at US$2.4 billion, half of which was invested by Bell Atlantic, this was the largest telecommunications acquisition in Asia/Pacific history.

The logic of our investment was confirmed quite dramatically in July by the overwhelmingly positive response in world markets to the initial public offering of Telecom stock. The demand for shares was extremely high.

Out of the sale, Bell Atlantic realized a one-time gain of about $75 million, which we are using to support long-term financial initiatives, such as capital recovery, restructuring and further business development.

New Zealand Telecom's performance has exceeded our expectations. With this first big offering out of the way, we're working even harder on developing synergies with Telecom, particularly in the new product and business development areas.

We've also been eager to explore additional investment opportunities in New Zealand that complement our basic business strengths.

Last May, for example, we teamed up with Ameritech and the two top cable TV system operators -- TCI and Time Warner -- to purchase a 51 percent interest in Sky Entertainment Television, which provides multichannel pay television services in New Zealand that can be successfully developed.

In Czechoslovakia, we are partners with US WEST and the Czech and Slovak republics in a joint venture called, "Eurotel." In September 1991, Eurotel marked a major milestone, placing the first call on Eurotel Cellular Service just 10 months after beginning the joint venture.

Eurotel's present capacity is 4,000 customers, and that will grow to more than 11,000 customers by the end of 1992. By the end of 1991, Eurotel also will offer packet data network services.

Eurotel represents a ground-floor opportunity in a country that urgently needs a modern communications infrastructure.

Elsewhere in July 1991, we announced that International Computers Limited had become part-owner of Bell Atlantic Customer Services International, whose companies provide computer maintenance services in Western Europe. We view this partnership as an ideal opportunity to support our business growth plans while providing customers with a more varied and rich portfolio of services to meet their business needs.

In a nutshell, our international strategy is characterized by an in-depth focus on prime markets and multiple opportunities that allow us to do what we do best -- add value to communications networks. We intend to be selective, targeted and smart., especially when it comes to long-term investment.

We view today's international marketplace as the opportunity of a lifetime. Driven by the need to extend basic service coverage to support economic and social development., countries are not only modernizing their telephone networks but are coming to believe that privately-owned telephone companies, not governments, are best positioned to develop and expand the telecommunications infrastructure.

Telecom privatization and competition offers enormous promise to a nation. It can attract additional financial, technical and managerial resources to the country.

In addition, by allowing commercially minded firms to participate in telecommunications, there could be an improved responsiveness toward customers and expanded coverage of telecommunications services. The efficiency of the workforce and network would also improve and prices for services would be brought in line to benefit all customers.

Other potential benefits include: expanding the availability of the types and geographical reach of new services; maintaining and expanding the asset value of the company; removing the day-to-day operation of the company from the national political process; reducing financial demands on the national budget; accelerating innovation and capital investment in the telephone network; and improving the quality of life of a nation's citizens.

In developing countries, they are also realizing that a modern telecommunications infrastructure is necessary not only for domestic economic growth, but also to be able to compete in world markets and attract foreign investment.

As a result, the privatization of the telecommunications infrastructure should be viewed as a vehicle to enhance economic development. As service improves, so will the business community's telephone usage and productivity.

But for all the promise that privatization and competition offers, there are also enormous challenges.

For companies, like Bell Atlantic, the challenge is to select wisely from the range of investment opportunities available today and in the near future.

Today, we know of nearly 30 telecom privatizations underway or under study in nearly every corner of the globe. It is widely agreed that there are more telecom investment opportunities today than there is global investment capacity to deal with them. And we believe that trend will continue.

There are some important considerations that influence the level of interest and competition in a privatization.

First is the amount of opportunity that exists to add value to the investment in growing revenues. This includes such things as:

- The country's economy -- as it is today and as it likely could be based on political and economic changes.
- The overall environment surrounding the privatization.
- The country's tax structure, limitations on foreign ownership, and dividend treatment.
- The degree of pricing freedom or regulation.
- The opportunity to improve existing products and introduce new ones.

There are also purchase considerations, such as: having the right partners; currency stability; acquisition expenses; requirements to sell down and opportunities to sell shares; financing arrangements; size of the company; and all the legal matters, such as property titles, liabilities and warranties.

For example, getting the very favourable conditions that attracted us to New Zealand was in itself an important and well negotiated. Access to company and the freedom to manage it.

Our decision to invest in New Zealand Telecom is also based on a number of other factors that will contribute, over an opportunity for profitable business expansion for Bell Atlantic and increased shareholder value.

And the absence of rate of return regulation meant that cost reductions and revenue stimulation directly affected the bottom line.

Making a profit on a temporary investment in New Zealand was never our primary objective, but rather the value for Bell Atlantic was in making a permanent, ongoing investment in New Zealand Telecom.

For governments, the challenge is to do what New Zealand did. And that is to create the right conditions and climate for privatisation.

Privatisation alternatives range from:

- The government hiring private individuals or companies as consultants and contract managers.
- Sharing profits with a foreign telephone company to manage the system.
- Selling part ownership of a company to raise capital.
- Selling controlling interest and management responsibility for the company to a foreign operator while retaining partial ownership for the benefit of employees and other domestic interests.

Many privatisations now in the planning stages involve companies that already have been "corporatised" or pushed away from the post office or the ministry to begin operating like a private sector company. New Zealand Telecom was "corporatised" about two years before it was privatised.

Related to privatisations - but stopping well short - are projects of private undertakings where telephone administrations have formed ventures with the private sector to accelerate the deployment and development of sensitive or critical telephone infrastructures.

Whatever the alternative, companies like Bell Atlantic are more ready to participate and to complete agreements which benefit governments and investors the right set of conditions that will improve the value of the asset.

Another important challenge is that selling a valuable national asset like a telephone system is an emotional issue. It is critical for foreign governments to have clear objectives.

The government must be realistic about the value of the asset and understand the motivations and future expectations of the buyers, as well as key opinion formers in the country including customers, unions, political supporters and opposition.

The temptation is to sell the property to the highest bidder without regard to the technical and service proficiency or other intrinsic values of the enterprise. The short-term profit gained, no matter how high, will not short the positive and potential benefits of privatisation.

A recent article in Business Week put it succinctly:

"Selling off state assets has to disruption and is no sure investment. It means that secure jobs are destroyed and confidence but inefficient practices are entrenched. But there will much choice anymore. Countries hanging out the 'For Sale' sign have a common set of needs to mobilise domestic savings, get foreign cash into their economies and create jobs."

The first - and perhaps biggest challenge for owners, customers and public policy makers alike is to turn the promise of privatisation, competition and emerging information technology into a strategic competitive advantage that benefits the company, its customers and the country.

[redacted]

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TABLE # 1 - SUMMARY OF MAJOR INVESTMENT BY REGION

Region	Invest 1990 $ bill	Popul. 1989 (million)	Average* Annual Growth in %(lines)	Subscriber Line(1989) (million)	Relation Line/100
Europe	43.0	685.4	5.7	195.9	23.4
N America*	30.0	340.0	2.9	143.6	52.7
Asia Pac Rim	28.0	3,156.3	6.0	105.0	3.3
L America	6.0	372.5	7.2	25.0	6.7
Total	107.0	4,554.2	5.0	469.5	10.3
TOTAL World	125.0	5,192.0	5.0	476.0	9.2

* Average between 1979 -1989
Note:1: Asia Pac Rim data include Asia and Oceania
2 North America include only Canada and U.S.
3 Latin America include Mexico and Caribbean and South America
source: The World Bank Annual Report(1989), Siemens International Telecom Statistic (1990), World Statistics United Nations (1988).

this include equipment, training and services. The world Telecommunication sector invested U.S.$ 116.0 billion in this sector in 1989 with an annual growth of 7.7% .

Perspective of the market: (1990/1996)

Total investment estimated is U.S.$ 927 billion.
Expansion of Subscriber access terminal is estimated in 170 million
1989 total subscriber access terminal: 476.3 million

Worldwide, there are a total of 476.3 million installed telephone lines, the average annual growth of telephone lines between 1979 and 1989 was 5.0%. The average number of telephone lines per 100 inhabitants in 1989 was 9.3.

5. The Telecommunications global market in the 90's

This marketing study focus in the nine major investment countries which are planning to invest major resources in the Public Telecommunications infrastructure during the next six years in the major regions of the world: Latin America, Europe and Asia Pacific Rim.

The countries by each region covered in this study was chosen not only as a major investor in Telecommunications in each region, but the potential in long term to growth in Equipment and services environment. The countries by region studied in details for this study is listed below:

Latin America: Brazil and Mexico

Europe: France, Italy and West Germany

Asia Pacific Rim: Australia, Japan, South Korea and Taiwan

note:The North American market are not covered in this specific study.

The table #1 summarize the major data of each region in the world covered in this study that are investing in Telecommunications by population, Per capita GNP and subscriber line. The Telecommunication networks with the liberalization factor in the worldwide market is gathering pace, spawning the introduction of new services and technologies.

The deregulation of phone markets has already lead to a partial globalization of the industry. Network operators in countries where the markets have already been deregulated, principally AT&T and the baby Bells in the U.S., British Telecom and Spain's Telefonica, have started to broaden their branch and expand overseas.

This diversification has been promoted partly by a feeling that their prompted partly by a felling that their opportunities for growth at home were limited by a desire on the part of regulators to reduce their market shares. It has also been prompted by a perception that international markets were full of opportunities.

6. The third wave of communication technology

Computing and Telecommunications are converging at least because information technology promises to become cheaper and thus more widely used. It is now worth building networks to gather and process data which earlier would have been paper bound or left uncollected.

This technologies are converging so suddenly because old monopolies have been broken. Competition has stormed through the telecommunications industry, and the rout is not over. Mr. Harold Green, the American Judge, broke up AT&T into a long distance carrier and seven regional telephone companies in 1984. By that time technology,

particularly satellite and microwave communications, had frustrated arguments for a natural monopoly in making distant connections. Likewise, the technology of mobile telephony is now undermining the arguments for a natural monopoly in local telecommunications. Moreover, the assumption that only a monopoly could afford the vast investment needed to build a country's network was outdated: a nationwide network was already in place.

Another concept called the intelligent network will sweep through telecommunications toward the end of the century. The equipment form which the intelligent network will be made abide by a universal standard. This means that many equipment makers will make products for it. The telephone companies will thus have a choice of suppliers.

The intelligent network separates features from switching. The features are programed into a normal computer which sits beside the network. Whenever a service is needed, the network fetches it from the computer and acts accordingly. This give the carriers at least two advantages. First, anyone can write the software for a new service since it will be running on a conventional computer. Second, only a few computers, need be on the network, which makes it cheaper to set up. This attract carriers because it allow them rapidly and cheaply to introduce new services, such as dial-up films or special telephone networks which are dedicated to a given subscribers.

The consequence of the intelligent network will be a fearful battle between switch makers and computer makers over the boundary between services that are switch based (those like call waiting, that are more popular) and services that are computer based (Voice Mail and other value added services). Even an electronics company that has both telecoms and computing outfits under its roof is likely to find that an old telecoms contract is passed on to a rival computer maker.

7. Major Market Trends

The major markets for telecommunications worldwide continue to be the largest buyer of telecommunications equipment, as North America, Europe, and the Asian Pacific Rim region.

The only significant growth is investment in long erm is likely to occur outside this region. Historically the trends confirm our estimative as you see in the table below:

Growth of main Lines per continent(1979/1989):

Region	Growth (%)*
Latin America	7.2
Asia Pacific Rim	6.0
Europe	5.7
North America	2.9
Worldwide	5.0

* Mean annual growth in % per annum
source: International Telecom Statistic - Siemens 1990

As a summary of the three regions covered in this study we present a total investment during the period of 1986 to 1996 for Latin America, Europe, and Asia Pacific Rim.

In Latin America, Europe, and Asia Pacific Rim regions, there are a total of 325.9 million installed telephone lines, the average annual growth of telephone lines between 1979 and 1989 was 4.9%. The average number of telephone lines per 100 inhabitants in 1989 was 7.7.

The Latin America, Europe, and Asia Pacific Rim region projected growth for the period of 1990 to 1996 is shown in the table below:

YEAR	Subscriber Terminal (million)	Investment (billion dollar)	Population (million)
86	273.8	55.5	4,022
87	289.6	59.4	4,083
88	306.8	69.0	4,143
89	325.9	75.0	4,206
90	345.0	82.0	4,269
91	367.5	89.3	4,325
92	391.0	96.0	4,388
93	414.5	103.7	4,440
94	440.0	112.3	4,492
95	465.0	121.0	4,541
96	493.0	129.8	4,593

8. Global Strategies in the Telecommunications Sector

The strategies in the 90's will be focus in the competition of telecommunications industry. To understand the traditional structure of the world's structure of the telecommunications environment is important to highlight some facts.

Historically, the majority of governments, except Canada and the U.S., have been encharged the provision of telecommunications services to a national monopoly. Telephone service was usually combined with postal and telegraph service in a government Postal, Telegraph and Telephone Administration, or PTT (Postal Telephone and Telegraph model).

In the majority of industrialized countries, the PTT procurement were directed to the growth of domestic telecommunications equipment manufacturing. The status of Telecommunications monopoly was preserved and recognized by most of the industrialized countries, and protected from any kind of foreign competition. This fact was unique from almost all other industries, and its special status is reflect today in the fact the most nations do not subject their PTTs to Government Procurement Code of GATT.

Monopoly service providers have little incentive to reduce costs or improve services. Ultimately, it is the consumer who must bear the burden of unnecessary high costs while being deprived of new products and services.

The major force for change in the U.S.A. has been competition, leading to liberalization, deregulation, and ultimately, the AT&T divestiture. Beginning with the liberalization of CPE policies in the late sixties and culminating with the divestiture of AT&T of its local operating companies, the U.S. government effectively opened both the equipment and service sectors for the U.S. Telecommunications industry to competition.

A driving force behind the procompetitive policy was the demand of network users for lower transmission costs and a large variety of equipment and services. The development of computer and the information society in the U.S.A. gave rise to increased demand for electronic information services in a wide variety of industries.

The effect of the liberalization in the U.S.A. have drawn-out to the International Telecommunications environment. The increased penetration of the U.S. market by international companies to see access in the largest market in the world in absolute value, has undertaken the U.S. Government to a number of initiatives to encourage foreign governments to remove Telecommunications market barriers, further straining the traditional market structure.

Technology is also a major contributing factor in the rise of global competition in the Telecommunication sector. The increasing integration of computer and telecommunications technologies has pushed a trend toward mergers, acquisitions, and cooperative agreement in the international Telecommunications suppliers environment.

9. Markets of The 1990's

The Telecommunications market in the 90's and beyond will be in a fast pace, with the industry cycle of the new products shorten as soon the competition pushing towards quality, price and time delivery factors.

The deregulation of Telecommunications market has already lead to a partial globalisation of the industry. Countries which have not embarked in this liberalization stage, it is becoming common to open the market for data and mobile communications which are its fastest growing sector.

Telecommunications market trends have been influenced in several ways by the technology of digitalization, trough the availability of satellite services, fiber optics and broadband availability. New technologies are more reliable and faster, offering a wide compatibility for applications of voice, video and data in the same circuit. ISDN the Integrated Service Digital Network will be one of the major services available for the International Business community in the major developed Telecommunications country.

The ISDN evolution currently in the international telecommunications environment establish at 144 Kbps in two 64 Kbps D-channels and one 16 Kbps channel to carry encoded voice and data.

10. Deregulation Worldwide

The Telecommunications policies of state governments worldwide and multilateral organizations have an important effect on the performance and ultimate competitiveness of the Telecommunications industry.

The escalation pace of technological innovation and steadily increasing development costs, combined with increased competition in the U.S. marketplace from International Telecommunications suppliers, are leading to additional pressures and incentives for U.S. companies to move into the international arena.

While the United States procompetion style have gained some acceptance abroad over the past five years, there remain substantial differences in the progress of deregulation from one country to another. These lead to a significant variance in market accessment for International Telecommunications equipment suppliers and services in the global market.

11. Conclusion

This study show that the Long Term trends of the largest growing market in the Public telecommunications worldwide investments would be Latin America. The Region are expected to invest more than U.S.$ 62 million representing a growth average of 24 percent and expansion of the access terminal 13% a year in average.

In absolute values the Europe and Asia Pacific Rim are the top region in the world surpassing United states in average growth respectively 14 and 5 percent in investment in the public telecommunications infrastructure.

In term of absolute value of terminal access expansion Europe long term trends are very satisfactory, with the inclusion of Eastern Europe in the market the number may increase more than we projected that is around 69 million new terminals for the period.

This market will be very competitive with the growing deregulation in the worldwide market. Price, technology, quality and service will be the key factors for suppliers of telecommunications equipment became a major player in this challenge Global Telecommunications environment.

Global Telecommunications Standardization and Regionalism

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1. Abstract

Global telecommunications standardization activities used to be an activity primarily indulged in by public telecommunications operators to allow basic interconnectivity of voice systems. Technological advancement and increasing deregulation and liberalization of telecommunications in the developed world have altered global standardization efforts through increasing domination by transnational telecommunications interests focusing on advanced digital services. Perhaps the most important structural change in the global telecommunications standardization regime is the regionalization of standards creation with major new initiatives in Europe, the United States, and Japan. Regionalism may also be a key for non-participants in the standardization processes to assure their input is considered.

2. Introduction

In an age of exploding multimedia dependent on digitization, all of the media become translatable into each other. Component bits migrate and any message, sound or image may be edited from one medium of transmission to another. This is the basis of interconnectivity. In turn these developments create an economic interdependence among producers, distributors and users of common facilities. The policy goals that define and constrain their relationships are of importance to society.

In order for government to provide for effective use of new communications technologies, it must promote standard setting processes. This is because new technologies create new communication pathways that need new gatekeepers to mediate dialogue. The most significant issue that emerges from these "technologies of freedom", as Ithiel de Sola Pool has defined them, is the concept of universal service. With the diversity of value added networks, the question arises of what constitutes universal service in an information age. For example, the growing use of PBXs and high speed data transmission for private business networks may drain the resources available to public switched networks. In such a framework the interoperability of the infrastructure itself depends on the availability of standards. The pricing system of new technologies like ISDN is heavily dependent on the acceptance of standards, without which vendors will be reluctant to enter the market. With the new freedom the RBOCs in the U.S. have gained to provide information without having to create separate subsidiaries [1] the distinctions among hardware, software and the network are disappearing. Most new technology is software driven and software defined, making future systems more flexible.

3. Background on Standards

Two of the most important worldwide trends driving economic, political, and social policy are the emergence of the information age and increasing internationalization. Global telecommunications standards are a crucial underpinning of these trends as they develop separately and as, together, they enable the emergence of the global village.

In just 20 years the international network has evolved from requiring human assistance for a voice call between most international points, to allowing unattended facsimile and data transmissions throughout most of the developed world. Global networks permit transnational corporations to operate internationally with most of the same capabilities that are available among sites in their home country (albeit with higher costs). And Integrated Services Digital Networks (ISDNs) may soon deliver the the capability for advanced network services to homes throughout the developed world.

This is all possible only through the development and adherence to standards; in this case agreements on how information technology devices communicate with each other. There is a growing body of literature on the economics of standards [2,3,4] in which the advantages, disadvantages, and processes are considered.

3.1 Incentives and Disincentives for Standardization

Ideally standards might be developed purely within the marketplace. However in many cases there may simply not be adequate incentive for individual players to develop or adopt standards, even when there are significant benefits to be obtained. As a matter of public policy then, government may mandate some level of standardization.

3.1.1 User Perspective

Users of information and telecommunications systems are widely considered to be major beneficiaries of open standards. Following are some of the key benefits of standardization for users:

- *Interoperability*
  Connectivity with large numbers of compatibly equipped other users provides significant externalities, e.g., for users of telephones, facsimile machines, and dialup modems.

- *Decreased costs*
  Standardization permits economies of scale in production, for example, by making mass production of specialized chip sets economical. Furthermore, the presence of multiple vendors of standard products in the marketplace generally leads to more competitive pricing and lower costs than in single-source markets.

- *Vendor independence*
  Users perceive value in the increased flexibility and decreased risk associated with portable applications; they need not be tied to the fortunes and practices of a single vendor.

- *Stable infrastructure*
  Standardization creates platforms on which advanced development may take place. For example, the emergence of the IBM PC bus as a standard enabled the development of a wide range of add-in boards with advanced functions that were not available on previous systems with smaller shares of the market.

Users may also be concerned about possible negative effects of standardization. These include:

- *Manipulation of standardization*
  Users worry that powerful vendors may use standardization as an anti-competitive tool by legitimizing proprietary technologies, resisting improvements, and switching standards at times that benefit their own competitive position.

- *Stifling of innovation*
  Adoption of standards may make it difficult or impossible to migrate to superior technologies as they become available. Use of the QWERTY keyboard layout, even in the face of proven superior alternatives such as the Dvorak keyboard, is an excellent example of this inertia effect.

3.1.2 Vendor Perspective

Vendors, on the other hand, may see open standards in a different light. Proprietary technologies, as opposed to open standards, may be used to exploit competitive advantage by providing vendors with:

- *Captive markets*
  IBM established and maintained its domination of the data processing marketplace through a complex set of proprietary systems that locked in users to IBM technology.

- *Advanced services*
  Standards nearly always lag behind the most advanced technologies. Non-adherence to standards frees vendors to take advantage of the latest developments in its product line, offering more advanced applications and products to users willing to purchase before the establishment of standards in new areas.

At the same time, vendors see that adherence to industry-wide standards can provide them with market advantages due to:

- *Increased interoperability*
  It is, of course, easier to sell a telecommunications product that interoperates with other vendors' equipment, particularly for a new vendor entering the market. This follows from users' general preference for standardized systems.

- *Expanded markets*
  Adherence to standards can increase the scope of a vendor's market. All users of the standard system are potential customers. In markets without standards a vendor may only be able to sell to customers who have selected their particular version of a technology. This is particularly the case in international markets, in which large vendors perceive adherence to global standards as a key to becoming viable suppliers in other countries.

- *Market leadership*
  Given users' generally positive perception of standards, a vendor that is an early adherent to a standard can capture early adopters of a new technology as customers. At the same time this enhances the vendor's image as a technological leader.

- *Stable infrastructure*
  Standardization can create many new market opportunities by providing a viable base for the enhancement of standard products.

3.2 Theory of Standardization in the Marketplace

In the marketplace, even in situations in which everyone benefits from adoption of a universal standard, it is possible that no such standard will emerge. And if standardization does occur, there is no guarantee that the best standard will be adopted. This is because there are many players with different interests and concerns. Standards can be an important aspect of the market's landscape, and each player may have tremendous incentives to either block standardization altogether or to insist on adoption of their own technology as the only acceptable standard. The success of standardization efforts will then depend on whether the perceived benefits of overall standardization outweigh each players' insistence on their own positions. If so, compromise may be possible which can facilitate a standardization process in which the entire marketplace realizes a net benefit. Otherwise, in situations in which there is an overriding public good to be fulfilled through standardization, government may have to step in and mandate standardization if it is to occur.

3.3 Standardization and Public Networks

The politics of network planning in Europe differs from the network fragmentation theory in the United States. The differences in political implementation far outweigh the structural similarities in the choice of technology for economic progress [5]. In Europe, the planning process for common standards is part of the political scheme for European integration. These decisions are grounded in economic theory. Economic efficiency and economies of scale imply an organizational solution to the problem of developing international standards. Public networks would ideally serve as a collective good for which stable user-network interfaces, OSI interoperability, integration and flexibility through easily programmable software are desirable technical features. But how the new infrastructure is implemented in the U.S. and Europe will ultimately depend on the political institutions that will implement these tasks.

From a global perspective, attempts at standardization have so far failed to reconcile the long-term need for digital infrastructure integration with the short-term need for specialized networks under decentralized ownership and user control. The theoretical argument is based on the movement from national public service requirements to a critical industry with a world market of $800 billion growing at 7% a year. The hypothesis is that competition rather than central planning of this high technology sector

will achieve greater economies of network integration than the natural monopoly generated economies of scale and scope. The rules of the game have changed so that hybrid distribution systems offer product differentiation to users of information services. These developments have challenged the traditional criteria of high costs and resource scarcity whereby unified access to the telecommunications system was mandatory. Without standardization and network integration, carriers cannot justify the high cost of providing broadband fiber-based access to the home.

4. Traditional Standardization Processes

International standards have traditionally been set by global standards organizations. International standards often describe interconnectivity of systems, leaving some details of user connectivity to be determined on a national or regional basis.

4.1 International Standards Bodies

Traditional standards bodies have a variety of backgrounds and focus on different areas. There are both treaty and voluntary bodies at both the international level and national levels, and regional bodies have been active in Europe. A major common thread in all telecommunications standardization has been the dominant role of the Public Telecommunications Operators (PTOs) and their preferred equipment suppliers. Usually the PTO has been a government entity (in most countries a PTT) and sometimes a regulated monopoly (e.g. AT&T in the U.S.). The preferred equipment supplier has likely been a national monopoly or the PTO itself.

4.1.1 International Telecommunications Union (ITU)

The International Telecommunications Union (ITU) is a treaty organization which specializes in telecommunications. Although it now operates under the auspices of the United Nations, the beginnings of the ITU go back to the mid 1800s and the development of the international telegraph network. Formal membership is restricted to governments, and most nations of the world retain membership. Standardization activities occur in two permanent bodies within the ITU: the International Telegraph and Telephone Consultative Committee (CCITT) and International Radio Consultative Committee (CCIR). The CCIR is primarily responsible for transmissions that occur through radio transmission, while CCITT is responsible for wired telecommunications standards. In practice there is increasing overlap between these two areas, particularly with the increasing use of digital transmission systems, and the two consultative committees work closely together when appropriate. Most of the actual standards work in the CCIs is done by private sector entities that are identified as Recognized Private Operating Agencies (RPOAs) or Scientific and Industrial Organizations (SIOs) by their governments.

4.1.2 ISO-IEC

The International Organization for Standardization (ISO) is an international voluntary body that promotes and facilitates standardization. Its membership is the national standards organization for each country, which may or may not be a government entity. A separate body, the International Electrotechnical Commission (IEC), is responsible for electrical and electronic standardization; all other areas fall into the purview of ISO. Together, ISO and IEC have formed a Joint Technical Committee 1 (JTC1) with overall responsibility for information technology standardization.

ISO and the ITU are headquartered across the street from each other in Geneva. Typically telecommunications standardization has been left to the ITU CCIs, and information system standardization has been handled by ISO. There is, of course, significant overlap between these two areas and the two groups work closely to avoid unnecessary duplication of effort. For example, in the crucial area of Open Systems Interconnect (OSI), many of the key standards are identical.

4.2 Typical Standards-Making Processes

Standards-making processes vary according the organization developing the standards, the nature of the standard itself, and the state of development of the particular technology in question. A typical process begins with the decision, generally made at the highest level of the standards organization, that a standard is required in a particular area. The task is then assigned to a particular study group or technical committee, usually composed of technical staff from members with an interest in that technology. The technical group works until it reaches consensus. Then the standard is ratified in some fashion back at the highest level of the overall organization. The final product of the process is generally considered to be a recommendation. It only has force of law if a legal authority within a particular country or region mandates use of the recommendation as a required standard.

4.3 Standardization outcomes

Sometimes consensus simply cannot be reached. This may be due to the opposition of one or more powerful participants in the standards process. More likely, however, it is due to an inability to agree on a particular standard for the technology in question. This can occur even when there is overriding benefit to standardization if the participants have strong vested interests in a particular standard or in blocking a particular standard. When, however, a standard is finally recommended, it may be the result of one of the following kinds of processes:

- *Standards construction*
  Standards may be developed from the ground up. This can be a slow, negotiated process, and many compromises may take place along the way. This takes place most often when standardization begins in advance of actual development and deployment, before participants in the standards process have a strong vested interest in promoting or blocking a particular outcome, e.g. their own or a competitor's product respectively. Standardization of Integrated Services Digital Networks (ISDN) is an example of this kind of activity. There are several potential dangers with this kind of early standardization. One is that by standardizing before a product or service is proven in the marketplace, it may turn out that there is little demand by users. Another problem is that standards set in advance of implementation may be technically flawed due to the lack of real-world experience with the technology, and may require significant revision or enhancement.

- *Standards adoption*
  In some cases an existing implementation is accepted as-is as a standard. This may be fast, but it may give

an advantage to the developer whose standard is selected. Competition among various implementations to be recognized as the standard may be fierce, and standardization process participants with no favored implementation may simply wish to block someone else's proposal to avoid yielding competitive advantage.

- *Standards adaptation*
  A new standard may be the result of a process somewhere between the previous two. An existing implementation may be the basis of a negotiated standard, after being adapted in accordance with the demands of other participants. The changes may be required to improve the standard functionally or simply to limit the competitive advantage of the original proposer.

- *Standards with options*
  Sometimes there can be no adaptation or compromise that garners consensus. In that case, some organizations will accept standards with multiple options, where each option corresponds to one of the proposals. This outcome is somewhat more effective than no standardization at all, since it may limit the number of options in the marketplace and permit some of the benefits of standardization.

4.4 Issues in standardization

The traditional process of developing international standards has been widely criticized. This section briefly considers the most common and serious issues raised regarding the process itself.

4.4.1 Slowness and bureaucracy

The formal standards setting process has been considered to be slow and burdened by bureaucracy. Even with new "fast track" procedures in effect [6], beginning a new standardization process after the need is perceived or competing technologies are on the market is too late. Videotex and color television standardization efforts are examples of the problems that occur when entrenched national standards are supported in international fora [7]. With the rapidly accelerating pace of technological advancement, this problem has become even more severe. In a competitive marketplace vendors will simply not wait for standards before developing and deploying new technologies that users need. It is now widely recognized that standardization must be more market-oriented and efficient [8].

4.4.2 Technical quality of negotiated standards

As standards are negotiated, particularly in the political setting of an international forum, technical excellence may be sacrificed to the pragmatic need for agreement and political considerations unrelated to the standard or technology under study [9]. Another problem is that standards developed in advance of implementations may be technically flawed, and require revision as lessons are learned through implementation efforts.

4.4.3 Resource requirements and distribution of costs

Active participation in the standards process is extremely expensive. It is estimated that hundreds of millions of dollars per year are spent on standardization [10]. Lengthy meetings are held in international locations. Perhaps more significant than the travel and lodging costs that must be borne by the participants' employers are the costs associated with the time and salary of these highly valued employees. Some active participants in the standards processes believe that the costs of standards development are unfairly allocated; that while they bear the bulk of the costs, numerous other non-participants have equal rights to develop products in accord with the resultant standards [11]. These non-participants benefit from the research and expense of the standards process without paying any of the costs.

4.4.4 Limited access to standards

The language of standards is sometimes thought to be obtuse; new terminology is often devised, critics claim unnecessarily. The standards have only been available in hard-copy, generally at prices high enough to serve as a deterrent to casual collection and inspection [7]. The ISO clearly states that their publication resale program helps support the organization. The CCITT is now beginning to make its standards freely available on-line [12].

4.4.5 Intellectual property rights

All cooperative standards organizations grapple with the relation of standards to intellectual property rights. Standards are, by intent, intended to be freely available and widely used. But there is the possibility that compliance with a particular standard may require use of a technology (e.g. patent) that is owned by an individual or firm. This would clearly compromise the standard and potentially the standardization process. Most standards organizations ask that participants openly declare their interests in any intellectual property that might be required for compliance with standards under consideration. Participants with such interests must be willing to agree to license their interests on a reasonable and non-discriminatory basis or work on the standard will not proceed. However there still remains the possibility of unintentional non-declaration, malicious non-declaration, or overlap between a standard and some intellectual property right of a non-participant in the standardization process.

4.4.6 Limited participation

Users seldom have the resources to be active players in the standards forums, although organizations such as the International Telecommunications Users Group (INTUG) and the International Chamber of Commerce (ICC) can serve as a voice for users. Similarly, lesser developed nations (LDCs) also lack the resources to actively participate. Non-participants sometimes claim that the scope and/or contents of the standards being developed do not address their needs.

5. Change in Regime

The quickening pace of technological advancement, increasing internationalization of business, and worldwide trends toward deregulation and liberalization of telecommunications have relentlessly spurred the demand for more open and timely global telecommunications standards. The ITU has had to reconsider its basic functions and structure in light of this changing landscape in order to attempt to retain its leadership role or even remain viable [13]. Similarly, the ISO and IEC have reconsidered their standardization processes in the face of fundamental changes in the technological environment

[14]. In this section we briefly describe one of the important changes in the telecommunications standardization regime that is taking place.

5.1 Regionalism

One of the most influential trends in standardization through the mid and late 1980s has been the emergence of what are generally referred to as regional standards organizations (RSOs). These organizations have grown out of the recognition that with the deregulation and liberalization of telecommunication authority, formal national or regional standards are required to ensure interoperability of public telecommunications systems. International telecommunications standards generally do not address all aspects of the system (e.g. the user-network interface) and sometimes leave options from which each country can choose. Therefore some standardization is still required on a more localized basis.

5.1.1 United States - T1

After the divestiture of AT&T in the United States it was clear that there would need to be coordination among the new carriers to assure continuing network integration and interoperability [15]. The Exchange Carriers Standards Association (ECSA) was created to meet this need. With the recognition that carriers alone could not set telecommunications standards, a more broad-based standards committee was formed under the auspices of ECSA. Beginning in early 1984, Committee T1 assumed responsibility for telecommunications standards in the U.S. T1 is made up of representatives of the carriers themselves as well as manufacturers, interexchange carriers, vendors, users, and others with an interest in telecommunications standardization. T1, like the CCITT in the international arena, is responsible for wired telecommunications standards.

5.1.2 Japan - TTC

Japan began deregulation of telecommunications in 1985. As in the U.S., it was recognized that standardization should be primarily a non-governmental activity. The Telecommunications Technology Committee (TTC), similar to T1 in the U.S., was established in late 1985 [16]. TTC has responsibility for standardization of radio as well as wired telecommunications technologies.

5.1.3 Europe - ETSI

The European Conference of Postal and Telecommunications Administrations (CEPT) was traditionally responsible for European telecommunications standards. As part of the impetus to create a single European market by 1992, the issues surrounding telecommunications were carefully studied. A fully integrated telecommunication system was considered crucial both for the role of telecommunications in facilitating the single market as well as due to the size and importance of the telecommunications industry itself (equipment and services). Regional standards to supplement international standards were a clear requirement, so in 1988 the new European Telecommunications Standards Institute (ETSI) was created with responsibility for both radio and wired telecommunications standardization [17]. Unlike T1 and TTC, ETSI includes administrations (governments) and national standards bodies in its membership. It also engages professionals on a for-hire basis to engage in standards development, as opposed to relying on voluntary contributions from the staff of its members.

5.2 New Summitry

The RSOs were not established to supplant the international standardization efforts of organizations like the CCIs. Rather they set standards in areas in which there are no international standards, and establish national or regional profiles in areas where the international standards are incomplete or allow options. However, as they began operation, it became clear that there was tremendous potential for conflict among the RSOs and CCIs, or at the very least for expensive and unnecessary duplication of effort. Furthermore, all the RSOs recognize the importance of global standards, both to assure interoperability of worldwide networks and to facilitate access to worldwide markets by their own telecommunications sectors.

Recognizing the need for coordination, these three RSOs and the CCIs met together at the first Interregional Telecommunications Standards Conference in February 1990 in Fredricksburg Virginia. Generally avoiding the political issues of formal relationships among governmental and non-governmental as well as regional and national organizations, the meeting, which has been dubbed the first "standards summit", was considered a success [18]. A second interregional meeting was held in September 1991 in Nice. The overall outcomes of this summitry so far are:

- Recognition of the preeminence of the CCITT in world-wide telecommunications standardization
- Agreement to continue working together to improve the efficiency and effectiveness of overall standardization efforts
- Agreement to begin using electronic communications technologies to improve interchange among the groups
- Agreement to work toward a coordinated work program and schedule
- Agreement on a number of high priority standards of common interest

The CCITT has agreed to not begin developing standards in areas under active study by the RSOs. The RSOs have agreed to work with each other to attempt to avoid situations in which conflicting and competing proposals are presented to the CCIs. And improved interaction through use of information technologies coupled with a coordinated work and meeting schedule is expected to improve the efficiency and timeliness of the standardization process.

5.3 Industry Alliances

A new trend toward the creation of industry alliances for standardization should also be noted as an important aspect of the landscape. Corporations are increasingly impatient and unwilling to wait for bureaucracies to function, and they recognize the importance of standards if new technologies are to succeed in the marketplace. Very mobile task forces of corporations interested in a particular technology can be formed quickly for specific purposes, allocate resources, and get on with the work while larger and less wieldy organizations are still discussing needs and

process. These industry alliances are often international in nature. It remains to be seen how they will fit in to the new regime.

6. Involvement of LDCs and NICs

Active participation in the global standards-making activities is quite expensive. Participants must attend numerous meetings away from home. And in addition to the costs of travel, housing, and research, the employers or sponsors of the participants lose their time and the benefits of their skills which could be applied to other projects. The result is that a relatively small number of ITU member nations are active participants in standardization. The lesser developed countries (LDCs) and newly industrialized countries (NICs), such as those of Southeast Asia, tend not to have the highly technical human resources required to support highly active involvement in the global standardization activities. And if they do, these are often the people their nations can least afford to do without as they attempt to build their national infrastructures.

One can question whether or not widespread participation in actual standardization activities is important to smaller countries without significant telecommunications manufacturing or export sectors of their own. Just as users believe they need greater input into the process, there is no reason to believe that LDCs and NICs do not share the same sentiment. While on the one hand, some of the grueling technical work of standards-making is really an engineering function, on the other hand many of the decisions on priorities and interfaces have direct impact on policies and infrastructure development.

The new standards summitry has made the long-acknowledged dominance of Europe, Japan and the U.S. more explicit. But the standards proposed by any or all of the RSOs arrive at the ITU as proposals and must still be approved within the appropriate CCI if they are to achieve status as a formal recommendation. It can be argued that this provides non-participants a point of access into the process that might otherwise be altogether unavailable.

Regionalism may be able to play an important role in helping these nations benefit more from global telecommunications standardization. Exercising regional purchasing power and developing regional training and maintenance capabilities can help provide some of the economies of scale available to larger nations. Regional participation in the standards process through shared representatives to important study groups and the establishment of regional positions on key issues may be possible. And development of regional profiles may be useful at times. The key is to find ways in which smaller, less developed nations may be able to improve their ability to benefit from new information technologies and internationalization by providing the sought-after universal access.

7. Conclusion

Today's global standardization activities are being driven by:

- The industrialized nations' needs for the timely development of highly technical standards for the interoperability of complex integrated digital systems;
- The growing influence and needs of transnational interests; and
- The explicit recognition of the increasing importance of work done by regional and national standards organizations in the developed countries.

In the face of rapidly advancing technological development and an increasingly deregulated and liberalized environment, much of the most important and influential standardization activity lies ahead. For much of the developed world narrowband ISDN technology is now available, integrating voice and data. Broadband ISDN is around the corner, promising to integrate video into the network. Development of Intelligent Networks is starting, using ISDN as a building block. Open network regimes in the largest markets are closer, which will open whole new areas to competition. And wireless personal communications networks are one of the fastest new growth areas in telecommunications. Regionalism in the developed world is already changing the telecommunications standardization regime. It may also play a role in bringing the benefits to the rest of the world.

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The Potential Impact of Europe 1993 Satellite Policy on Economic Integration in the Pacific Area

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ABSTRACT

The 1990 Green Paper of the Commission of the European Communities sets the policy goal of the liberalization of satellite services as a cornerstone leading to a single market for satellite communication. After one year, what is the situation with respect to the proposed implementation action plan regarding the earth and space segments as well as the harmonized introduction of the high definition television (HDTV) standard? Are the national regulatory regimes moving faster than the European recommendations? What is the impact on the user, the private operator, the telecommunications organizations and Europe's satellite industry? What are the chances for building a bridge for further economic integration between Europe and the Pacific Area, as a reaction to fractional strategies leading to products and services divided among multiple suppliers?

In November 1990, the EC Green Paper proposed four major changes in the satellite policy of the European Communities: (1) full liberalization of the earth segment, including both receive-only and transmit/receive terminals, (2) free access to space segment capacity, (3) full commercial freedom for space segment providers, including direct marketing satellite capacity to service providers and users, (4) harmonization measures as far as required to facilitate the provisions of Europe-wide services.

In the light of the existing issues, the EC Commission has proposed that a series of actions be taken. In the case of earth segment, these include the following items:

- a text extending the coverage of a directive on the approximation of the laws of the member states concerning telecommunications terminal equipment - including mutual recognition of their conformity, to cover all transmit/receive satellite earth stations, and receive-only satellite earth stations connected to the public switch network;

- a directive for a Community scheme concerning the mutual recognition of licenses for satellite terminal networks, laying down the conditions for the Community-wide operations of such networks, including conditions regulating hub station operation;

- a draft decision aimed at strengthening frequency coordination in the satellite communications field;

- proposals for support measures for the European satellite industry, in particular in the field of satellite terminals;

- acceleration of support for the European standardization programme in the field;

- refocusing of relevant EC research programmes in the field, on short-term effects for supporting specifically European capabilities in VSAT terminals and system technologies.

For the case of the space segment, the Commission intends to pursue actively, within the framework of EEC competition rules, a debate with EUTELSAT and the member states on how best to achieve the goals of free access to space segment capacity and commercial freedom for space segment providers. In particular, the Commission will seek to ensure that the future scope for alternative offers of space segment capacity competitive to EUTELSAT shall not be impeded.

The Commission will pursue with the satellite and earth segment industry how best to assist in ensuring that they are not placed at a commercial disadvantage vis-a-vis their US and Japanese competition by the advent of a more liberal regime for satellite communications in Europe. In particular, efforts will be made to ensure equivalent opening of corresponding markets in these two countries.

Equally, the Commission will identify the corresponding steps relating to the two global international satellite organizations, INTELSAT and INMARSAT, to ensure that the treatment afforded to the three organizations is coherent.

The final directive is planned to be submitted to the EC Commission as soon as possible. This directive, once adopted, will have a considerable influence on telecommunications, broadcasting, audio-visual and space industries as well as the many new users and service providers, such as education and training institutions. And these new arrangements may impact considerably on Euro-Pacific relationship in terms of new and future economic opportunities in terms of progressive elimination of discriminatory regulations and practices.

What are the latest developments in the field of the high definition television

standards? End of November 1991, the European Parliament voted to approve the plan to introduce HDTV to the EC market but, at the same time, added ammendments which would lower the cost to consumers. The Parliament also agreed in principle to a package of subsidies for broadcasters, manufacturers and cable operators to help make the switch to HDTV. However, the Parliament's amended proposal, which must still be redrafted by the EC executive Commission, may be opposed as too interventionist by some EC governments.

The Parliament voted by a wide majority against a Commission proposal to require all new, large TV sets to have special decoders able to receive high-definition broadcasts after 1993. The decoders would have added substantially to the price of a TV set to consumers. Instead, the Parliament proposed that TV sets be equipped with "standardized sockets" so that the special decoders can be installed as an accessory.

The Parliament adopted HD-MAC, the technology jointly developed by Dutch Philips Electronic NV and Thomson SA of France, as the future standard for HDTV broadcasting. The EC subsidies package would include aid for both companies. However, the Parliament voted to maintain tough conditions for broadcasters by requiring them to begin transmitting in a transitional HDTV standard, D2-MAC, once EC legislation comes into effect. To make the change more palatable, the Parliament agreed in principle to direct subsidies to help satellite operators to simultaneously broadcast conventional and HDTV signals.

The EC Commission will deliver an improved HDTV strategy to EC telecommunications ministers when they meet on 5 December 1991 at Maastricht in order to define their new legislation on satellite transmission standards which expires at the end of the year. A more relaxed directive may satisfy the needs of European broadcasters which have built up an audience for programmes transmitted using different norms, whereas Philips and Thomson have already invested heavily in new technology based on existing EC legislation.

Besides these developments, it should be noted that leading electronic companies originating in different countries in the world are now working together on HDTV. A joint collaboration between French and Japanese teams will implement a system converting the European HD-MAC standard to the Japanese MUSE standard. In addition, Sony and Matsushita (JVC) are holding talks to buy Thomson licences of D2-MAC which would amount to 3.6 or 8 ECUS per TV set, depending on the nationality of the firm and its industrial commitment in the EEC. At the same time, eight Japanese and two American companies have agreed to work together to develop large scale integrated circuits from Japan's HDTV sets. The aim is at sharing the huge cost of developing smaller, cheaper, more sophisticated integrated circuits by 1993 in order to speed the popularization of HDTV. This agreement follows similar collaboration announced previously by Japanese firms.

These few examples show many striking features. Introducing a complex new product like HDTV involves coordinating a whole array of often conflicting interests, those of broadcasters, national governments, film makers, satellite operators and electronic companies. A proliferation of competing formats will lead inevitably to a fragmented market for some time. In the medium term, history may repeat with HDTV like with videocassette players during the 1980s, when electronic concerns launched three competing types and when only one prevailed, and that one was based on a Japanese standard. If lessons are to be drawn from history, setting standards would indeed be of little use as a protectionist tool. Europe's PAL and SECAM standards have not prevented Japanese and Korean manufacturers from obtaining an increasing share of the EC market for TV sets.

In light of the preceding analysis, a major change of the regulatory environment seems necessary. That is why I would like to submit the following policy proposal regarding increased co-operation between Europe and the Pacific Area in the field of satellite policy, in order to exploit fully the existing Euro-Pacific synergies.

Parties concerned, together with relevant national, regional and international organizations, should work towards the establishment and adoption, where appropriate, of international standards.

To this end, better information on the standard process is required, as a reference for decisions to be taken and in view of the utmost importance of such knowledge in the context of the rapid technological developments at national and international levels. Participation of all interested parties would benefit the discussions, at a preliminary stage, leading to the elaboration of a given standard. An additional point would be the consideration of all possible elements in the analysis conditioning the formulation of the best possible standards. In trade policy terms, this would mean inter alia (1) monitoring closely the standard process to evaluate properly the cost-benefit parameters; (2) understanding the implications of an emerging standard, in terms of its usefulness, its potential profitability of alternative emerging standards; (3) ensuring maximum transparency in standard processes, with adequate platforms for discussions and mutually recognized testing facilities; (4)reinforcing efforts towards open functional standards so that compatibility and interoperability, along with increasing networking, facilitate switch-over to new technologies.

The above policy proposal should be replaced in its global strategic context, that is whether public and private interests want to favour investments, jobs creation, growth of world trade or whether preference is given to political and economic confrontations. Europe is the highest economically integrated region of the world. The Pacific Area, embracing the Americas as well as the Far East, is on the cutting edge of dynamic economic growth. Countries in the region

currently produce nearly half the world's output of goods and services and account for more than one-third of global trade.

Countries in the Pacific Area are improving actively telecommunications at home in order to sell services to nearby nations. East Asian countries now want to build and launch new commercial satellites in the region. The Republic of Korea, Thailand and Malaysia have decided to compete with Japan, China, Hong Kong and Indonesia as providers of regional satellite links. This new trend will reduce the region's reliance on INTELSAT for television, radio, telephone, facsimile, telex and data transmission via satellite. Satellite operators will in future compete on the basis of low price and quality of the service, including specialized facilities for education, commerce and industry.

There is a growing demand for a full range of high quality communications services to keep pace with rapid economic growth in the Pacific Area. Korean Telecom, a government agency, is due to announce the prime contractor for its first-ever communications satellite project, with about $400 million, in the next few weeks. Companies bidding for construction of two satellites include Hughes Aircraft Co. and Loral Aerospace, both of the United Sates, and British Aerospace PLC of Britain. The satellites are due to be launched in April 1995 and October 1995.

Malaysia recently signed a memorandum of understanding with Hughes for at least one, and probably two, communications satellites to be launched by Arianespace, the European space-launch consortium.

Once the first Malaysian satellite is operational in 1994, it may save up to $15 million a year on use of foreign satellite facilities.

The Indonesian government, which operates two satellites and lease circuits on them to state and private companies in Malaysia, the Philippines and Thailand, would launch a third satellite in July 1992, on a US Delta rocket at a cost of $72 million. This would bring the launch forward from 1995 to meet rapidly growing domestic and regional demand.

In Thailand, a locally listed telecommunications company, Shinawatra Computer Co., has signed a contract with Hughes to build two satellites for launch in 1993. The Thai government in July 1991 awarded this Company, which is 9.5 per cent owned by Singapore Telecom, exclusive rights to operate Thailand's first commercial satellite network. The company was given a 30-year concession, including an eight-year guaranteed monopoly, for the project. But the government has indicated recently that it might modify the Shinawatra contract to allow greater competition.

Overarching all this are the world-wide GATT multilateral negotiations whose successful conclusion is to be one of the most critical economic policy issues facing the international community. One does not underline enough the significance for each of the economies in the Pacific Area and in Europe, of an open and strengthened multilateral open system. A major and significant outcome to the GATT negotiations on goods and services trade, including telecommunications, is necessary to underpin the growth of world trade, to forestall protectionist pressure, to instill confidence in markets and to facilitate the continuation of economic reforms where this is needed imperatively.

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This paper is strictly personal and does not commit the GATT in any way.

Causality Between the Telecommunications Sector and the National Economy

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ABSTRACT

Formal analysis of the causal relationship between the telecommunications sector and the national economy has often been neglected, despite the wide acceptance of the notion. Such an analysis will be helpful in extending our understanding of the relationship. In addition, clarification of the relationship will contribute in establishing rational investment priorities among competing sectors of the economy of which the telecommunications sector is a component. Granger causality test is utilized in this study to formally clarify the issue.

1. Introduction

It is widely accepted that telecommunications and the national economy are closely related to each other. This notion is supported by the claims that the telecommunications sector requires huge investments which in turn demands healthy financial support from the national economy and that the national economy is boosted by the high value added telecommunications industry. These claims not only pose interesting questions to economists but also have important policy implications. The first idea implies that a higher priority should be placed on the telecommunications sector, while the second argument suggests that the priority should be shifted to other sectors of the economy, preferably with high value added and less capital intensive industries. An analysis of these claims will be useful, especially for those countries with limited investment resources, for efficient resource allocation and establishment of rational investment priorities are crucial.

Surprisingly, though, few studies attempt to clarify the causal relationship between the telecommunications sector and the national economy, which is the motivation of this paper. The result from an empirical analysis of the relationship in Korea and some selected countries suggests that the causal relationship is not decisive. However, there seems to be a tendency that the telecommunications sector is preceding and causing the national economy in less developed countries while the situation is reversed in advanced countries. The organization of this paper is as follows. Section two discusses the methodologies of the causality test and the related issues of stationarity and co-integration. Section three discusses empirical results of the causality test in Korea and some selected countries, with implications and conclusions contained in the last section.

2. Methodologies

The test of causality and the macro-economic input-output analysis may be utilized to clarify the issue. These methods have different uses. The causality test reveals which variable causes which variable. That is, it tests whether a change in a variable causes and preceeds a change in another variable. On the other hand, the input-output analysis has a limited use in clarifying the question of which of the two variables causes the other. In the input-output analysis, flows of products among industries are tabulated, and the inter-dependences of the industries are identified. Impacts of an industry on others may be analysed on different points in time (usually every 5 years) to obtain a comparative static view of the industrial structure of an economy.

In the present study, the causal relationship between the telecommunications sector and the national economy is analysed utilizing the causality test suggested by Granger. The number of telephone lines (or the size of the exchange capacity where available) and constant price GNP (current GDP for foreign countries) represent the telecommunications sector and the national economy, respectively.

Common econometric practices when analyzing the relationship between the telecommunications sector and the national economy are to regress the former on the latter. The reason for the practices may be that, in estimating and forecasting telecommunications variables, national economic variables, such as GNP, are employed without a verified causal relationship between them. It also seems that such practices are based on the common and vague belief that the telecommunications sector and the national economy are closely related each other. These types of regression analyses can only be justified by their generally high explanatory power as indicated by R^2.

Another problem may come from the fact that these equations are usually estimated by the OLS (ordinary least squares) method. Recent studies by Granger and others warn that the OLS method does not yield consistent and efficient estimates when the series concerned are non-stationary and not co-integrated each other. It is likely that a time series with a trend (GNP is a typical example) is non-stationary. Consequences may be that if the other variable-- in our present study, the number of main telephone lines--is also non-stationary and if both variables are not co-integrated, the estimates from the OLS regression are spurious. Therefore, it is necessary

that we inspect the two variables for stationarity before any regression is done. If they are found to be stationary, it is fine to use the OLS. If not, it has to be clarified whether they are co-integrated. If they are co-integrated, the OLS will be consistent. Otherwise, the regression will be false and meaningless.

Unit root tests, of which Dickey-Fuller test is the most popular, test the stationarity of the variables. If the coefficient α_1 in the regression,

$$\Delta X_t = \alpha_0 + \alpha_1 X_{t-1} + u_t,$$

is significantly different from zero, the hypothesis that X has a unit root is rejected. That is, X is found to be stationary. However, in testing the significance of α_1, the usual t statistics may not be used. Instead, t statistics in Granger & Newbold must be used, as in table 1 below. As can be noted, the critical values are greater than the usual critical values for the t-test.

When and if the variables are found to be non-stationary, it is necessary to find out whether they are co-integrated by running a regression of the form

$$X_t = \theta\ Y_t + u_t\ .$$

If X and Y are co-integrated, that is, if there exists θ (called the co-integrating scalar or vector) such that a linear combination of X and Y (X - θY) is stationary, the OLS is able to provide a consistent and efficient estimate of θ. Specifically, we may test whether the residual of the above regression is stationary by the unit root test. Alternatively, we may also test whether the autocorrelation coefficient of the above regression is significantly different from and smaller than unity by inspecting whether the DW statistic is significantly different from zero. If the residual is stationary or the DW statistic of the above regression is significantly different from zero, X and Y are co-integrated such that X - θY is stationary and the OLS method is justified. Critical values of the DW statistics for the test are also included in Table 1 below.

Critical Values \ Significance Levels	1%	5%	10%
t statistics	3.77	3.17	2.84
DW statistics	0.511	0.386	0.322

Note: From simulations based on 100 samples with two random walk time series.

TABLE 1. CRITICAL VALUES FOR UNIT ROOT TESTS

After the preliminary test for the unit root, we proceed to the causality test. Of several methods, we will utilize the simplest Granger test. This method checks if lagged terms of the independent variable have additional explanatory power when lagged terms of both the dependent and independent variables are included in the regression. If that is the case, the independent variable is said to cause the dependent variable. This method uses the usual F test.

3. Estimation Results

3.1. Stationarity Tests

Data utilized in this study are Korean quarterly GNP in 1985 prices from 1970:1 to 1989:4 and the number of telephone lines from 1981:1 to 1991:1. Estimated lag structures of the variables, according to the estimated partial autocorrelation coefficients, are such that GNP have five lags while the number of telephone lines has one. The estimated lag coefficients are as follows.

$$GNP_t = \underset{(-.4)}{-72.15} + \underset{(6.6)}{.64}\ GNP_{t-1} + \underset{(.3)}{.007}\ GNP_{t-2} + \underset{(.6)}{.01}\ GNP_{t-3} + \underset{(47.1)}{1.0}\ GNP_{t-4} - \underset{(-6.4)}{.64}\ GNP_{t-5}$$

$R^2 = .994$, DW = 2.26, SSR = 21,812,229,

SSE = 562, degrees of freedom = 69

$$Exlines_t = \underset{(2.0)}{110{,}032} + \underset{(166.2)}{1.03}\ Exlines_{t-1}\ ,$$

$R^2 = .999$, DW = 1.73, SSR = $78*10^{10}$,

SSE = 142,946, degrees of freedom = 38.

Note: Exlines denotes the number of telephone lines, and numbers in parantheses are t statistics.

Getting the estimated relationship, we now proceed to test for unit roots.

$$\Delta GNP_t = \underset{(1.9)}{1{,}881} - \underset{(-1.69)}{0.10}\ GNP_{t-1}$$

$$R^2 = 0.036, \quad DW = 2.84$$

$$\Delta Exlines_t = \underset{(2.0)}{110{,}032} + \underset{(4.3)}{0.026}\ Exlines_{t-1}$$

$$R^2 = 0.33, \quad DW = 1.73$$

We find that GNP has a unit root while the number of telephone lines does not. Since GNP has a unit root, we need to test if both variables are co-integrated.

$$Exlines = \underset{(-2.75)}{-2{,}019{,}682} + \underset{(13.4)}{450.8}\ GNP$$

$$R^2 = 0.84, \quad DW = 2.06,$$
degrees of freedom = 34.

From the DW statistics, we find that they are co-integrated. We accept that both are co-integrated in the sense that a linear combination of them is stationary even when only GNP is non-stationary.

3.2. Causality Test-Korea

Since both GNP and the number of telephone lines in Korea are co-integrated, we now discuss the causal relationship between them. F tests are used with 5 lags of both variables in the regression, for GNP was estimated as a fifth order autoregressive process. The estimation and test results are summarized in Table 2 below. As indicated in the table, the null hypothesis that either GNP or the number of telephone lines does not have any additional explanatory power when the lagged terms of the other variable are included in the regression cannot be rejected at the 10% significance level.

That is, the causal relationship is meager so that the other variable does not have additional explanatory power when the lagged terms of the dependent variable are included. It is noteworthy that although the F statistics are not significant in both cases, it seems that the number of telephone lines causes GNP more than GNP causes the number of telephone lines, as indicated by the relative magnitude of the statistics. Thus, at least during the sample period in Korea, a regression of GNP on the number of telephone lines seems more appropriate.

Dependent Variable			GNP	Telephone Lines
Independent Variables	Intercept		7380.9 (2.5)	-314,300.4 (-0.5)
	GNP	lag1	0.29 (1.4)	20.3 (0.5)
		lag2	-0.22 (-2.4)	10.7 (0.6)
		lag3	-0.22 (-2.5)	10.9 (0.6)
		lag4	0.81 (8.8)	26.3 (1.4)
		lag5	-0.54 (-2.6)	-17.9 (-0.4)
	Telephone Lines	lag1	0.0005 (0.5)	1.2 (5.0)
		lag2	-0.0006 (-0.4)	-0.4 (-1.3)
		lag3	0.0014 (1.0)	0.8 (2.6)
		lag4	-0.0008 (-0.5)	-0.7 (-1.8)
		lag5	0.0012 (0.7)	0.1 (0.3)
Statistics	F Statistics		1.91 [0.14]	0.97 [0.46]
	R^2		0.994	0.999
	DW		2.317	2.042

Note: Significance levels in square brackets and t statistics in parantheses. F statistics are for the hypotheses that the lagged terms of the variable in question do not have any additional explanatory power when the lagged terms of the dependent variable are included in the regression.

TABLE 2. CAUSALITY TEST RESULTS

Few points deserve special attention. Firstly, there may be a problem of instantaneous feedback. If the instantaneous feedback occurs within the frequency of the data, the causal relationship detected above may be invalidated. The use of the quarterly data is to avoid the problem as much as possible, and the probability of the instantaneous feedback between GNP and the number of telephone lines occuring within a quarter seems to be fairly low. Secondly, since both the F statistics are not significant, the causal relationship in one direction is not necessarily stronger than the one in the other direction. All that can be said is that a causal relationship in one direction tends to be stronger, with definite conclusions to be drawn with further evidence. Thirdly, the telecommunications sector is a part of the national economy GNP figures represent. Hence,

in a sense, one may argue that our discussion of the causal relationship between the telecommunications sector and the national economy is similar to arguing whether consumption causes GNP or not when consumption itself is a part of GNP. However, the telecommunications sector is not as large as consumption, albeit growing, in the national economy. Thus, the growth in the telecommunications sector may not cause statistically significant changes in the national economy when other sectors are instantaneously growing as well. In addition, our regression exercise is analogous to running a standard regression of consumption on national income while consumption is a component of the national income at the same time.

If we tentatively accept that GNP is caused by the number of telephone lines, the regression yields,

$$\log (GNP) = \underset{(475.6)}{0.630} \log (Exlines)$$

$$R^2 = 0.831, \quad DW = 2.392,$$
degrees of freedom = 41.

The elasticity of 0.63 implies that 1% growth in the number of telephone lines causes GNP to grow by 0.63%.

The Korean telecommunications industry was lagging behind the growth in the manufacturing industries in the 70s, but catched up rapidly with other sectors in the 80s, backed by strong demands from industries and consumers and by sustained investments made possible by healthy economic growth. It will be very interesting to find out whether the causal relationship in the 70s and the 80s are any different. Unfortunately, however, the Korean experience in the 70s cannot be empirically evaluated at this time, due to the lack of appropriate data.

3.3. Causality Tests-Other Countries

The investigation of the causal relationship between the telecommunications sector and the national economy for other countries is performed using the annual data from ITU. Gross Domestic Product (GDP) and the number of telephone lines (or capacity where applicable) of those countries are used. The regression equations take the same functional form as before, except for one year lag due to the different data frequency. Although the data sets for the countries are rather small covering 70s and 80s, consistent and interesting results are obtained. R^2 is usually greater than 0.9, DW statistics indicate no serial correlation, and the variables are co-integrated for virtually all countries considered. The result of the F tests is summarized in Table 3 below.

The F tests are the same as before. Of 32 countries considered, the majority have insisgnificant F statistics, suggesting the possibility of feedback. In addition, for those countries with significant F values, no obvious causal directions seem to exist. For example, GDP causes the growth in the telecommunications sector in South Africa, Ecuador, and Sri Lanka, while the causal direction is the opposite in Indonesia, Bahrain, and others. However, it is interesting to note that advanced countries and less developed countries have distinct patterns. That is, advanced countries, except for Germany, have a tendency that GDP causes the telephone lines, while two thirds of 27 less developed countries have the opposite causal direction.

Countries	F_{tel}	F_{gdp}
Japan	0.83	0.23
Germany	0.38	0.63
France	0.57	0.16
United Kingdom	0.48	0.16
Italy	0.43	0.07
China	0.31	0.65
Mexico	0.24	0.60
South Africa	0.41	0.004**
Poland	0.06	0.07
Columbia	0.18	0.68
Saudi Arabia	0.013*	0.99
Malaysia	0.56	0.67
Singapore	0.62	0.84
Indonesia	0.008**	0.68
Syria	0.46	0.68
Ecuador	0.11	0.02*
Morocco	0.28	0.04*
Arab Emirates	0.04*	0.85
Kuwait	0.07	0.34
Cyprus	0.98	0.04*
Panama	0.03*	0.67
Zimbabwe	0.29	0.81
Sri Lanka	0.56	0.008**
El Salvador	0.796	0.798
Paraguay	0.84	0.06
Bahrain	0.001**	0.63
Bahamas	0.97	0.02*
Zambia	0.36	0.98
Fiji	0.70	0.88
Papua New Guinea	0.02*	0.28
Malawi	0.046*	0.011*
Rwanda	0.99	0.22

Significance levels for the respective F statistics.
* **: Significant at the 5% and 1% level, respectively.

TABLE 3. CAUSALITY TEST RESULTS FOR SELECTED COUNTRIES

The result indicates that the telecommunications sector is following the national economic growth in advanced countries, while the same sector may be considered as a leading indicator of the national economy in less developed countries. The reason may be that, in less developed countries, a higher priority is placed on the telecommunications sector and the sector is receiving a preferential treatment in their economic development plans so that the sector is expanding faster than the national economy. In fact, many developing countries place heavy emphasis on expanding their basic telecommunications networks to facilitate their economic growths. On the other hand, the result may also indicate the fact that the growth in the basic telecommunications sector in advanced countries is slowing down. With the use of the cummulative number of the telephone exchange lines as representing the telecommunications industry in a country, the above result may well be anticipated. More comprehensive indicator of the telecommunications industry may be needed in order to further clarify the causality issue.

4. Implications and Conclusions

The causal relationship between the telecommunications sector and the national economy does not reveal itself decisively in Korea and the majority of the countries we considered, possibly due to smaller samples and instantaneous feedback. Nevertheless, the result provides some useful insights. That is, it seems that the telecommunications sector causes or preceeds the national economic growth in less developed countries including Korea, while the opposite tendency is more visible in advanced countries.

As discussed above, the telecommunications sectors in developed and less developed countries may be in different development phases. The result that the telecommunications sector tends to cause the national economic growth in less developed countries may be a reflection of the preferential treatment the sector received in those countries. Nevertheless, the econometric analysis in the present study reveals that the causal direction seems to be from the telecommunications sector to the national economy in less developed countries. It, therefore, suggests that the higher priority has been and should be placed on the sector in those countries. The input-output analysis may help in determining how much emphasis should be placed on the sector.

Some limitations of the present study deserve a brief discussion. The telecommunications industry has been represented by the number of cumulative telephone lines in the study. With the importance of the enhanced telecommunications industry growing recently, the plain old telephone service may no longer be an accurate criterion of how large or developed the sector is. Therefore, our finding should be interpreted accordingly, with one minor justification that the number of plain old telephones may still be highly correlated with the size of the sector, especially in less developed countries, in which case our analysis retains considerable validity. Secondly, as with any empirical study, the result is conditional on the past history and there is no guarantee that the future will reproduce the past. Thirdly, the instantaneous feedback may adversely affected our causality analysis, particularly for those countries with annual data.

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THE CHANGING ECONOMIC ROLE OF TELECOMMUNICATIONS

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1. Abstract

The spread of networking is pushing the telecommunications industry beyond connectivity towards an interpenetration with the enterprise sector, and therefore beyond its traditional utility role. This paper, with special reference to Hong Kong, sketches out some of the conceptual and policy issues which require more detailed empirical research. It represents the start of a research project, not its conclusion.

2. Introduction

The full effects of the micro-electronics revolution on the telecommunications industry have yet to show themselves despite the enormous changes that have already taken place. This is partly due to the ongoing nature of technical change and industry innovation within the paradigm of digital communications. But it is also due to the transformative implications of the digital era for entire economies. National economies, most notably that of the United States, are forging ahead into what is loosely described as the 'information age', while elements of the world economy, in particular the activities of multinational corporations, finance and global trading companies, are increasingly dependent for production, cost and marketing information and co-ordination upon computer-generated digitally-transmitted data telecommunications.

So, in practice there are radical changes taking place within the telecommunications industry, and equally radical, but still underdeveloped, changes taking place in the input-output relations between traditional telecommunications companies and the wider economy. This paper sets out to raise some of the issues and problems posed by the inter-action of these two aspects of change.

3. Incremental and Radical Change

Changes that take place purely within a given technological paradigm without changing it in any substantial way are usually referred to as incremental changes. Examples abound of alternative methods which form sub-parts of the overall system. For example, the use of reed-relays in analogue switching, or the development of time division as opposed to space division multiplexing. Where incremental changes induce partial shifts out of an existing paradigm, we could perhaps term it 'incrementally transformative'. Certainly the invention by Strowger of his original switch was transformative, as was the subsequent shift from manual to automatic.

Changes which alter the fundamental principles along which communications are designed, and thereby break the paradigm, are commonly described as radical. There is no question, for instance, that the invention of the microprocessor has had radical effects upon all the technologies to which it has been applied, including telecommunications. But more fundamental was the prior invention of binary language, and the subsequent invention of digital transmission. This universal machine 'alphabet' has produced a transformation of technology which first went beyond hardware into software, and, therefore into 'artificial intelligence', and has now progressed into firmware, and probably has many more stages to go.

The key element to arise from among these radical changes is, in my view, that of artificial intelligence. What makes this key is not the intelligence itself, but the possibilities of it being remotely accessed. On its own, this has opened up networking possibilities, through interconnectivity, which are transforming all types of economic and social activity, killing some off, and giving birth to others.

4. Networking

It is through networking that the telecommunications industry enters, let us say penetrates, the inner commercial life of enterprises, and potentially the inner social life of households. Previously the supply of the plain old telephone service was just an external connection with the world. It penetrated less deeply into the office, the factory or the home than other utilities, such as gas, water and electricity. These other utilities are directly used as inputs in production and consumption activities, such as heating, powering, washing, cooking, and so on, to a degree which went beyond the normal usage of telephony. (Of course, large scale industrial consumption of gas, electricity, etc., is usually organized separately from, or additionally to, the public utility grids.)

But networking has changed all that. Telecommunications has leapfrogged other utilities in the degree of its input into these activities. The way for its doing so was prepared by the computer revolution. From design systems such as CAD-CAM to production systems such as MAP, and from office systems such as TOP, to reservation systems such as SABRE, and not forgetting the basic PC software programmes run from the home, digital communications

networks laid down an infrastructure that could be connected.

The public telephony network, even when predominantly analogue, was drawn into these developments fairly early on. PCM (pulse code modulation) techniques enabled the analogue network to transmit digitally-coded voice and data between exchanges or between data terminal equipment. In the case of Hong Kong, for example, the H.K.Telephone Company introduced PCM as early as 1962 in PABX equipment, and introduced PCM into the public switched telephone network as early as 1967, giving cause for the Company's inhouse journal "Hello" to proclaim itself "in the forefront of technical advance" (December 1967).

Public data networks, often as overlays in the first instant, were the next step. The Macau Telephone Company (CTM), a very small administration by world standards, offers a good recent example of this development. A digital data network now overlays the public switched network offering data circuits and packet switching, but because this network is operated independently, and would not, for instance, survive a restart procedure in the event of a crash in the PSTN, it does not, as yet, offer the full range of services, such as virtual networks. It is therefore a good illustration of the time, planning and investment required to transform an old analogue system into the latest technology.

These public data networks exist to win business from private users. To do that they must encourage private user networks to interconnect, but that interconnect is also the first step towards penetration. The data transmitted is typically computer-generated and computer-stored. From the transmitting end the public network just receives for onward carriage, but at the other end there naturally arose the possibility that the data received had been in some way enhanced, perhaps reformatted, or perhaps stored before delivery or routed to find the lowest-cost transmission path, or perhaps delivered to multiple destinations. The generic term 'value-added' is a loose one, but 'value-added' networks were the obvious next phase. Within the term 'value-added' can be identified quite different types of services. Some clearly enhance the data. Others simply save money by store-and-forward techniques and routing routines. Others package and sell 'information' as a commodity, yet others just transport the information packaged and sold by others. But in many cases the information or data in question is fed directly into the machine-technology which lies at the heart of many commercial activities. In other words, the information, which is generated beyond the enterprise, is used directly in the wealth-generating process of the enterprise.

It is at this stage of network development and connectivity that we can properly say that telecommunications goes beyond the traditional functions of a utility. Telecommunications goes beyond being just a form of transportation or means of carriage. Therefore the National Telecommunications and Information Administration (October 1988, p.3) of the US Department of Commerce was not wrong to say that

> "Today is the 'Information Age', and telecommunications comprises its chief transportation system."

but it does not go far enough. It does not fully recognize the telecommunications function as becoming part of the directly productive economy in a way which far exceeds the traditional role of telephony, or that of the other utilities. Indeed, in many cases the micro-electronics revolution has diminished the relative importance of energy inputs, and information technology has substituted for both labour and energy requirements. Flexible manufacturing systems, and Just-in-Time work routines, both of which save on resource use, would not be possible without telecommunications services.

5. Connectivity and Inter-Penetration

One of the important areas of value-added services is connectivity, the ability of a value-added network to connect one company's private network to other networks which do not share the same architectures or use the same protocols. This service offers value-added service operators the opportunity to market themselves as managers of networks on behalf of companies. Small or medium-sized firms with limited resources or know-how often find this to be a cost-effective solution when their business depends to a high degree on communications.

What this development is in effect doing is to bring the network operator right into the heart of the firm's commercial activities by running facilities that would otherwise be internal to the firm. Of course, how far this goes will vary with circumstances, but it is what I would term 'penetration' as opposed to simple connection.

Value-added network operators are usually companies with substantial experience in the computer industry, although telephone companies also offer VANS. In the case of Hong Kong, for example, Hong Kong Telecom offers a wide range of network services, especially to local firms, but they tend to involve less enhancement than, for example, the range of value-added services offered by companies like IBM. This market 'division of labour', which is the subject of a current research project, perhaps reflects the traditional specialization of companies coming from the two different ends of the computer-telecoms sectors.

But there are direct parallels between the two sectors, even as they overlap, if not merge. Centrex is an obvious example, whereby a telephone administration attempts to draw business onto the public network by substituting for the traditional PABX. Again this goes beyond connectivity towards penetration. At the heart of this penetration lies the ability of the private company to access, remotely, the artificial intelligence programed within the public switch, and the ability of the telephone company to provide the service, such as direct

dial-in, call-waiting and forwarding, voice messaging, etc.

6. Telecommunications and Competition

But penetration can go both ways. Remote accessing means that an enormous technical and commercial potential exists for bringing telecoms applications directly into companies, and indeed for the migration of certain functions from the public to the private domain.

Two major factors would seem to be at work here. First, the spread of private networking through the economy. This is likely to be a function of general economic development, and of the advancement of an economy from an agrarian and manufacturing base towards a tertiary economy and a world trading status.

Second, the relative cost advantages involved. These will be determined by, among other factors, the geography of the operating environment and the pace of technological advance. Geography will influence relative costs, for example of switching and transmission, or of cable versus microwave, whereas technological advance will bring different systems within affordability, compatibility, and so on.

In a major study of these developments for the US Department of Justice, Peter Huber (**The Geodesic Network**, 1987, p.1.3) puts it thus

> "Fiber-optical cable has slashed transmission costs for high-density applications, but the last mile of the network, where about half the transmission expense arises, carries mostly low-density traffic. In the past fifteen years, on the other hand, revolutionary developments in electronics have slashed costs of switching and other forms of network intelligence. The inexorable trend is therefore to move switching out toward the end user. Making connections at a distance costs more in increased transmission than it saves in lowering the number of connections needed. As a result, every network node is sprouting new arms."

But in the case of Hong Kong the economics differ. Because business and residential subscribers are packed into a small and densely crowded territory, telephone exchange areas tend to be small and exchange multiples large, averaging around 40,000 lines. To quote the General Manager, Engineering, Mr Peter Skerrett (Teletopics, March 1989)

> "The capital expenditure profile to provide telephone service is markedly different from many other urban cities. Unlike them, our potentially expensive items are land and buildings and the least expensive being external cabling."

Other things being equal, the economic profile of the Hong Kong PSTN would therefore tend to work against the migration of switching from the exchanges out towards private network nodes. A further disincentive to such a development is the absence of a local voice message-rate in Hong Kong, and all domestic calls are local. Thus there is little incentive to by-pass the PSTN for voice calls, or for fax. And since leased circuit prices are kept low within Hong Kong, there would be less incentive to build private networks, involving private cabling or microwave transmission, which by-pass the public network.

But there are other, independent, reasons why enterprises wish to develop networks, and carrying voice and fax alongside data and possibly video to connect suppliers, buyers or agents may well become a future feature of networking within Hong Kong as elsewhere.

7. Hong Kong's Special Economic Character

Undoubtedly one important source of impetus which operates in Hong Kong arises from the growing insistence by international clothing retailers that their many Hong Kong-based suppliers of fabrics, garments and sportswear switch over to some form of EDI (electronic data interchange). There is, in other words, a strong 'pull' factor involved here, emanating from beyond Hong Kong.

Unlike Singapore, where the Government decided that Singapore shall have EDI, the Government in Hong Kong has been painfully slow in formulating an EDI policy and seems to be torn between the market-led solution and the dirigist approach. But if the Government decides in favour of at least a partially State-led initiative, the spread of electronic communications systems among smaller and medium-sized businesses is likely to accelerate significantly.

A second strong source of EDI and private network systems within Hong Kong comes from local large companies, especially in the broad fields of transport (shipping, air-freight and passenger, the Metropolitan Rapid Transit system, the Kowloon-Canton Railway, cabs, trucking) and finance and trading houses. Naturally, it is among these companies that the most sophisticated equipment users and private network operators are to be found.

These larger companies dominate network use and international communications from Hong Kong, and it is their commercial activity, together with the excellence of Hong Kong's public telecommunications facilities, that draws multinational companies to use Hong Kong as a regional communications hub. But it is the dominance and nature of small and medium-sized firms which really differentiates Hong Kong from many of its neighbours, giving Hong Kong its unique economic and social character.

Table 1 provides a broad overview of Hong Kong's domestic industrial-economic structure, 1980-1988, which for a working population which grew

from around 2.3 million to around 2.8 million (from a total population which grew from just under 5 million to just under 6 million) immediately suggests a preponderance of small employers. The figures in small brackets represent the percentage contribution of each sector to the gross domestic product. It will be seen that the private sectors which have grown in economic importance are the wholesale, retail, restaurant and hotel trades, the personal and community services sector, and utilities. The first two of these sectors have a very high percentage of small businesses. The employment/establishment ratio in wholesale, etc., fell from 6.4 to 6, and in services fell from 11.4 to 10.9.

TABLE 1

Establishments and Persons (000s) Employed By Public and Private Sector in Hong Kong

(Percentage Contribution to GDP at Current Prices in Brackets)

	1980 Est.	1980 Staff	1988 Est.	1988 Staff
Public		136.2		185.5
Private				
Mining/Quarry	19	0.8 (0.8%)	7	0.5 (0.1%)
Manufacturing	45,025	907.5 (23.8%)	49,843	837.1 (20.1%)
Gas & Electricity	4	9.3 (1.3%)	3	10.9 (2.5%)
Construction	1,239	90.5 (6.7%)	1,249	76.3 (4.8%)
Wholesale/Retail, Import/Export, Restaurants and Hotels	70,766	455.1 (20.4%)	118,278	711.3 (23.8%)
Transport, Storage Communication	2,761	77.3 (7.5%)	4,828	115.5 (9.2%)
Finance, Insurance, Real Estate Business Services	10,872	131.6 (22.8%)	22,584	235.5 (19.2%)
Community, Social, and Personal Services	14,626	168.0 (12.5%)	20,600	224.8 (14.6%)

Source: Hong Kong Annual Digest of Statistics 1990

From Sit and Wong (1989) - see note to Table 2 - we can see the dominance of small (less than 50 persons) and medium-sized (50-199 persons) firms in HK. Together they made up 98.9% of

TABLE 2

Percentage Share of Small/Medium Firms in Manufacturing Establishments/Employment/Output

1985	Est.	Emp.	Gross Output
Food	98.5	68.8	66.3
Beverage	62.5	7.7	-
Tobacco	-	-	-
Garment	98.2	72.7	69.6
Leather	100.0	100.0	87.7
Footwear	98.9	81.6	79.8
Textiles	98.5	75.1	67.7
Wood	99.9	99.9	-
Furniture	99.9	97.6	86.9
Paper	99.9	98.2	85.7
Printing	99.5	80.0	68.5
Chemicals	99.8	92.5	69.2
Rubber	100.0	99.9	-
Plastic	99.3	75.7	72.6
Non-metallic	98.5	76.3	50.7
Basic metal	98.7	67.4	45.1
Fabricated metal	99.6	84.0	82.6
Machinery	99.9	92.8	84.2
Electrical	91.3	45.4	46.3
Electrical parts	95.4	41.8	30.6
Professional	98.1	66.0	61.9
Transport	98.0	41.0	31.5
Others	99.9	96.0	88.8
All	98.9	71.9	65.4

Source: Sit,F-S and Wong,S-L (1989) **Small and Medium Industries in an Export-Oriented Economy: The Case of Hong Kong** (University of Hong Kong, Table 3.2. See original for reporting problems.)

manufacturing establishments by 1985, employed 71.9% of manufacturing workers, and accounted for 65.4% of manufacturing output (gross value) and 64.1% of manufacturing value-added. (See Table 2) All these proportions were higher than in 1971.

As they point out, the fact that small and medium-sized firms have grown in significance as Hong Kong's economy matured is testimony to their entrepreneurial flair and relatively high productivity rather than to backwardness and low productivity as would be the case in some other economies. But smallness inevitably means certain weaknesses to the Hong Kong manufacturing base, especially in the area of research and development. Economies of scale are not available to support such activities. But economies of scale are attained in another way, by a high degree of specialization by small firms in their range of production which enables them to afford to use automated equipment. (See Sit and Wong, 1989, p.28).

They further stress the important role of import-export houses which provide the marketing services essential to the survival of these small firms. Much of Hong Kong's manufacturing

base depends upon international sub-contracting arrangements which often hub in Hong Kong, but pass on further to Macau, Southern China and other Asian countries.

Now those kinds of arrangements clearly involve considerable communications because the chain is long, and also because the chain branches out. On the other hand, the specialist role of import-export houses probably acts to limit the total communications of any one small firm. So, on the face of it, this structure would not tend to generate a great demand for telecommunications among the producers themselves.

At another level, the essentially small-batch character of specialized production, characteristic, for example, of fashion goods industries, has lent itself elsewhere (notably in Northern Italy) to flexible manufacturing systems which are intensive users of telecommunications. Increasingly Hong Kong's manufacturing base is slipping across the border into Southern China where labour is considerable cheaper and plentiful, and this can be expected to retard greater capital intensity within the industries concerned, and possibly retard also greater communications and information-intensity.

This poses an important strategic issue for Hong Kong. Will the manufacturing base just wither away, and will the tertiary sector be capable of generating sufficient tradeable services to maintain living standards and rising expectations? Or is there scope for a leaner manufacturing base to shift to higher value-added tradeable output? If the latter course is pursued, the role of telecommunications would be a vital element in the restructuring of industry. Seeing telecommunications in this light is to examine it as a possible catalyst of change, whereas traditionally it has been treated only as responding to changes in demand. The provision of electronic infrastructures and the marketing of services tailored to small businesses ahead of demand, and in anticipation of future change and growth, are activities where markets and public policy could meet each other.

The more obvious source of growth in demand for telecommunications services and the use of private networking in Hong Kong lies within the tertiary sectors identified in Table 1 as growing in economic significance. Many of these activities do constitute tradeable services, most clearly those associated with the tourist and business travel trades. The spread, domestically, of reservation systems and network information services, quickly spring to mind.

The highly active property markets in Hong Kong are also another potential source of demand for information services, but the significant moment would arise when these were interconnected with networks devoted to finance and loans data. That would be the point when networking would go beyond an information service 'bought in' and would penetrate the commercial activity of property agents and finance houses.

Many of these developments are already well established, or are rapidly being established, in advanced economies like the United States. But for most countries of the Asia region, including the tiger economies (tigers are more real than dragons, and perhaps less exclusively Chinese!) they are just beginning to unfold. But they are doing so at a time when the computer-based digital technologies of telecommunications are growing beyond their adolescence, which means that appropriate and affordable technologies are now becoming available for smaller enterprises and less wealthy communities.

8. Policy Implications

There are two key areas in which policy will need to develop the role of telecoms in territories like Hong Kong. The first will be the question of network growth itself. It is obviously central to the long term competitive advantage of an economy, both regionally and globally. In the case of Hong Kong it may well be that the services offered across the PSTN, the public data network and the value-added services networks will be vital to the spread of company networking.

The second is the question of competition and choice provided by the telecommunications industry. When telecoms was simply the PSTN and not a lot more, its utility role was foremost. Competition could only be conceived in terms of alternative public networks. In the age of private networks, with growing technical and economic opportunities for the migration of telecoms functions across networks as interconnectivity gives rise to interpenetration, there also arise new opportunities for entry, and new points of entry

But this is likely to be selective entry. Possibly by sector. For example, transportation companies already have well-developed global closed-user group networks which have potential for wider access and usage. Likewise, cable TV systems clearly offer enormous opportunities. Possibly by niche markets. For example, bulletin boards could become entry points for a whole range of consumer services.

For a small territory like Hong Kong, these are vital, possibly strategic, issues. They point to the need for the authorities to view telecoms policy in a broad light, and not in narrow terms of public network competition alone. Privatization and public network competition were very much the themes of the 1980s, but that was a decade of transition. The trends outlined above suggest the terms of public policy need to be very much more comprehensive than previously conceived.

Toward An Intelligent Wireless Network

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1. ABSTRACT

This presentation describes the evolution of wireless networks from today's emphasis on wireline connections to tomorrow's emphasis on services and global accessibility.

2 WIRELESS COMMUNICATIONS ENVIRONMENT

2.1 *WORLDWIDE TREND TOWARD WIRELESS NETWORKS

This trend is occurring because people want mobility,flexibility and useability with their telephone communications. As European borders become more open, citizens will be traveling more frequently from country to country. They want to be able to take their wireless phones with them everyone and make calls within a different country as if they were at home. Further, they want flexibility in how the call is handled and the way it is charged.

Telecommunications companies and agencies want to provide wireless networks because they can more quickly activate a new telephone. Wireless networks in many Physical facilities are not sufficient to meet the demand for new telephones. Wireless systems are less expensive to develop and deploy for the same reason - no wires have to be routed from a switch to the telephone user.

As such, wireless networks are clearly an alternative to wireline networks. In many countries, wireless is complementary to wireline networks. The promise of global accessibility through personal wireless communications is the major force behind wireless in the industrialized nations.

2.2 TECHNOLOGY TRENDS AND DIRECTION

Analog wireless networks are less expensive that digital networks to implement, and are satisfactory in may countries. When the number of analog channels becomes saturated, digital networks can increase the wireless network's capacity. The digital equipment that enables more calling is expensive, but may be the only solution. Digital processing systems allow for user accessibility on computer databases and provide better integration of both voice and data.

World technical and operational standards are changing to keep place with technology improvements. The leading European work is GSM (Groupe Special Mobile, an active constituent of European Telecommunications Standards Institute [ETSI]). The GSM pan-European Digital Cellular Radio Standard has been developed with the agreement of telecom administrations and industry from western Europe. The standard is intended to remain for 20 years as it relies on state-of-the art digital technology. GSM operates in the 900 MHz frequency band, and will coexist with other cellular services such as TACS (United Kingdom, Spain & Italy) and NMT 900 (Nordic countries and Germany).

GSM provides a standard approach to cellular switching, computer databases (for roaming and user verification), network management, signalling, radio equipment, channel and speech coding, security and data services interfaces.

Roaming is the ability of people to travel from their home locations across intervening countries to a final destination widely separated geographically from home and still be able to use their wireless phone. The ability to roam freely will facilitate cross-border travel and country transition in an open European community.

Technical standards for both analog and digital networks focus mostly on frequency allocation and encoding techniques.

Equipment required for wireless networks are switches for Mobile Service Switching Centers (MSC), microwave or landlines to connect the cells, the requisite radio transmitters/ receivers and transmission antennas, voice data encoding units, cordless user telephones, and computers to mechanize operational management functions.

Operations management systems for wireless networks provide for information processing similar to that used to manage wireline networks. For example, new users must be enabled at the MSC, and their data record added to record filing systems in order to track and charge them for on-the-air calls. The performance of the network must be

monitored and evaluated. Problems detected must subsequently be remedied. IBM has a major interest in providing computers for operational management systems.

2.3 PLANNING FOR WIRELESS NETWORKS

In industrialized as well as newly developed countries, considerable planning for and deployment of wireless networks is taking place. Where backlogs for basic wireline phone service exists, wireless networks significantly reduce the time required to meet demands for telephone.

Telecommunications companies and agencies in countries with well-established wireline networks and low demand for new phones provide wireless networks for the mobiles segment of their population. Wireless network operators in North America, Europe and Japan, for example, have requests for new services. These include free phone calling, voice store and forward, and universal telephone number. These services require computer databases that are located within the wireless network or are accessible in a wireline network. Networks with computer databases are called "intelligent." IBM has investigated intelligent networks, and believes its knowledge of computer data management techniques and its computer and database products can make intelligent wireless networks.

3. WIRELESS NETWORKS

3.1 TYPICAL CELL IN A WIRELESS NETWORK

A typical cell or geographic area in a wireless network serves the needs of both mobile and fixed location users. The Base Transceiver Station (BTS) is the heart of each cell. It operates on a dedicated set of radio channels which are different from the channels used in adjacent cells.

3.2 CELLULAR WIRELESS NETWORK

A group of base stations is controlled by a Base Station Controller (BSC) for functions such as handover and power control. Transmissions among cells and BSC's is with microwave and landlines. A group of Base

Station Controllers is served by a Mobile Services Switching Center (MSC) which routes calls to and from the public switched or data wireline networks.

The MSC sets up the call and then routes, controls, and terminates the call. It also manages the inter-MSC handover and supplementary services, and for collecting charging and accounting information. (Figure 1.)

(BTS, BSC & MSC are GSM terms)

4. COMPARISON OF WIRELESS & WIRELINE NETWORKS

Three wireline networks are local, long distance and common channel interoffice signalling system (CCIS). Comparing these to wireless is instructive for three reasons:

1. to highlight the physical differences and functional similarities
2. to show how they interconnect : and,
3. to illustrate how wireless networks can use CCIS for call set up to wireline networks

4.1 TYPICAL WIRELINE NETWORK

The service area for local telephone company is a city, province, state, or multiple local areas which may be geographically dispersed. Between the separate service areas, a long distance network is needed to provide call paths. Local telephone switches have large numbers of local lines for business, government, and residential access.

4.2 INTERCONNECTION BETWEEN A WIRELESS NETWORK AND LOCAL WIRELINE NETWORK

This inter-connection is necessary in order to connect mobile or personal users to parties in locations such as an office building, school or hone where wireless phones are not available. Cables between the MSC and local switch make the inter-connection possible. (Figure 2)

4.3 TYPICAL LONG DISTANCE WIRELINE NETWORKS

Long distance wireline networks differ from local wireline networks largely in the

geographic area served. The switching equipment has fewer lines and more trunking capacity, and the transmission equipment relies on microwave links and satellites along with both copper and optical fiber.

4.4 INTER-CONNECTION BETWEEN WIRELESS & LONG DISTANCE WIRELINE NETWORK

This inter-connection is necessary to connect wireless users with parties in distant locations. This may be a city 500 km or 5,000 km away of in another country. Such links may be between a wireless caller and another wireless receiver or between a wireless caller and a wireline party.

4.5 COMMON CHANNEL SIGNALLING SYSTEMS (CCIS)

These wireline networks were developed over 20 years ago in the United States for the purpose of setting up calls external to the interoffice trunks. As such, CCIS is an "out-of-band" signalling system that bypasses the trunking network so as to determine if a call can be set up without using trunk channels. This makes for a more efficient

Cellular Wireless Network

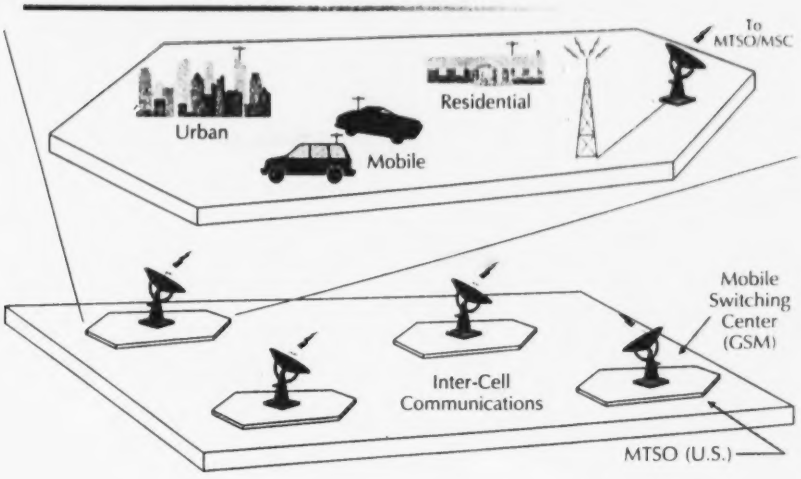

FIGURE 1

Inter-Connection Between Wireless And Wireline Networks

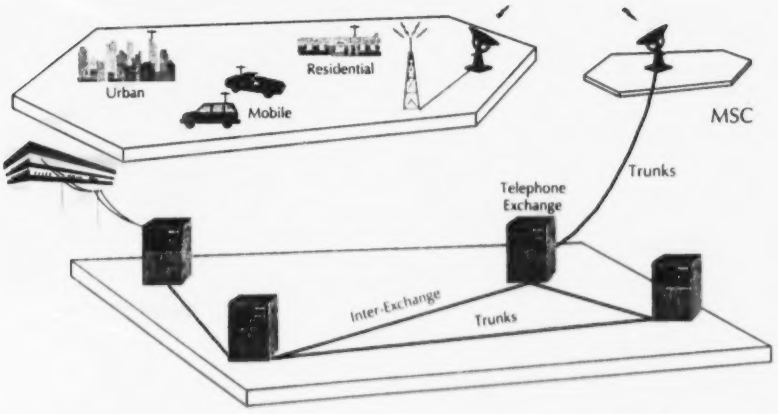

FIGURE 2

use of expensive trunks and allows for more call revenue to be derived from the available trunks.

Early CCIS used a protocol developed by AT&T called CCS #6. In recent years, common channel signalling has worldwide use and the international standards setting organization CCITT developed the CCS #7 standard protocol. This is based on the ISO telecommunications model.

4.6 USE OF CCIS FOR WIRELINE NETWORKS

CCIS call setup is performed by the flow of specialized messages from the originating switching center to the terminating switching center. The originator interrogates their terminator to determine if the line being called is available. If so, the phone of the party being called is rung by the switching exchange office. Simultaneously, a message is sent to the caller's phone. When the party being called lifts the phone off its hook, the call path is completed. After, both parties hangup their phones, the circuit is removed from service by the CCIS messages.

4.7 USE OF CCIS FOR WIRELESS NETWORKS

Call setup is done by the MSC in the GSM standard system. Thus, wireless users who call distant cells on wireline trunks have their calls set up with the facilities of the CCIS and CCS #7. Within the CCS #7 standard there is the Mobile Application Part (MAP) designed for use in the MAP and are carried to the database computer. The database computer responds to the user request and sends its reply via the MAP within the CCS #7 protocol. More will be said about MAP and database access later. (Figure 3)

5 WIRELESS OPERATIONS MANAGEMENT SYSTEMS

5.1 SYSTEM FUNCTIONS

Providing the physical connections and equipment for both wireline and wireless networks is only part of the job of deploying communications networks. Numerous other jobs remain to be done in order to manage these networks. Records must be created for users, physical facilities, line assignments, inventory, network performance, and so forth. This information must be processed and presented to those persons responsible for daily operations, administration and maintenance. Modern telecommunications operators rely upon computing systems to provide the electronic media necessary for storing large amounts of information needed for managing the network.

5.2 TYPES OF COMPUTERS

This chart shows three kinds of computers: a large mainframe for database storage and bill processing; a distributed processing computer; and, a desktop workstation.

The large computer system is required because of the large numbers of files that must be maintained, and the extensive processing required for the applications of call rating (how each call is charged to the user); user billing, invoicing, and printing; and, roamer processing.

The distributed processor is used to control and manage the service order system either within a central customer center of remote

point-of-sale location. The important applications for the distributed processor are service order entry and records maintenance, financial data processing and switch management. (Figure 4)

5.3 MSC FUNCTIONS

The latter is important to the quick activation of telephone service. The MSC switch is connected directly to the distributed processor. When service is requested, a file is created for the new user and an identification number is sent to the switch to enable immediate use of the network to place calls.

The MSC also sends call data records to the billing processor. This automatic input of call records eliminates the need for magnetic tape storage at the MSC switch, and more quickly and accurately updates user billing records. Such accuracy is important to roamer processing to ensure that the most current data is available on the use of the system/

IBM will provide operations management systems in partnership with software vendors.

6. DEMAND FOR WIRELESS SERVICES

6.2 LIFELONG, UNIVERSAL TELEPHONE NUMBERS

People who travel or move locations frequently have a desire for keeping the same phone numbers no matter where they are.

6.3 DIRECTORY ASSISTANCE AND CALL FORWARDING

Users of wireless networks may need to get telephone numbers from the telecom in order to complete a call. As such, they should have a number to call to get operator assistance. Once they have the number, the operator should then be able to connect the user to the party being called (Call Forwarding).

6.4 CREDIT CARD USE AND VALIDATION

Telephone credit cards are a major benefit to business persons and travelers who make frequent phone calls from outside their

Use Of CCIS

Wireless

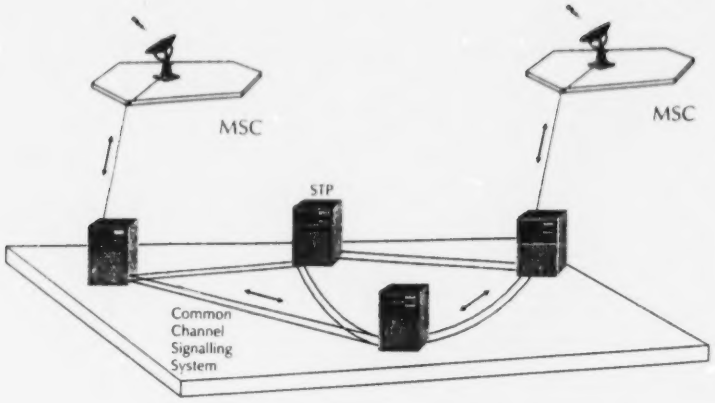

FIGURE 3

Wireless Operations Management Systems

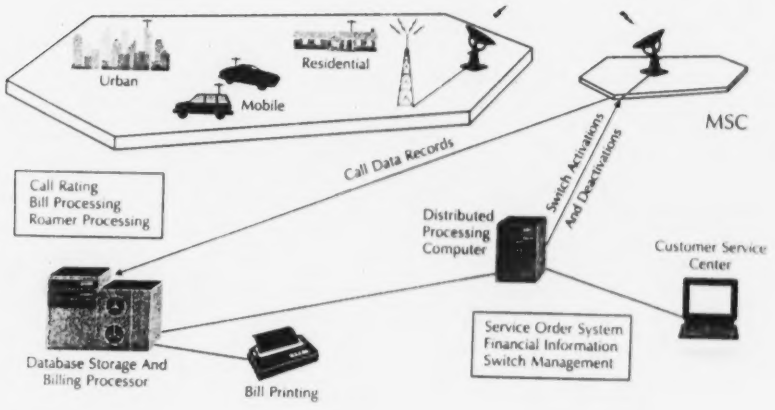

Figure 4

offices and homes. The credit card number is keyed into the numeric pad on the phone and is validated prior to connecting the call. Wireless users will use credit cards as much or perhaps more than a typical wireline user.

6.5 SELECTED FREE CALLS

In most industrial countries, businesses may subscribe to the telecom for a phone number that a customer or client can call with no charge. The business pays for the call. The objective is to increase the number of business calls to provide for more sales and increase customer satisfaction.

6.6 EMERGENCY CALL FROM ANY LOCATION

Telecom agencies and companies are learning that providing emergency telephone service is not only socially important but also an important source of revenue. Wireless users may have more occasion to use an emergency service because of their increased mobility.

6.7 ROAMING (HOME & VISITOR LOCATION REGISTERS)

This requirement for wireless users has been discussed previously. This capability is one of the most obvious benefits of wireless communications technology.

6.8 VOICE MAIL

The capability of leaving a message for someone else in your own voice is a service that has wide spread acceptance. It is an especially useful service whenever a person is traveling extensively.

All the services briefly described here require computer databases that are accessible through the wireless network.

7 INTELLIGENT WIRELESS NETWORK

7.1 CELL DATABASE

Wireless users who need access to a database service may have their request serviced through a local MSC database or... (Figure 5)

7.2 WIDE AREA DATABASE

Their request could be for database services accessible through the common channel signalling system. Today, wireline systems use such a database access scheme for wide-area services. The CCIS is an excellent location for such databases as they cover a wide geographic area. (Figure 6)

7.3 ROAMING

This service is an example of how a database service operates. In Europe, the GSM has decided that it is mandatory that all operators offer roaming service to visitors from other countries. (Figure 7)

The first task for a visitor is the selection of the system to which he wants to connect when outside his home location. Assuming that the home location system is not available at an adequate signal strength, then the user must select from a display of available systems.

Once this is done, then a Visitor Location Register record can be created for this user. When this record is created the VLR signals the HLR with location information in order to retrieve the necessary data for that subject. The subscriber also must be authenticated by the HLR to avoid fraudulent calls.

The roaming system also should be able to properly route calls with the visited area and to charge accordingly. A number of complexities can arise based on where the call originates and terminates within a visited area. Agreements among the mobile networks operators within adjacent and neighboring countries is essential to ensure that roaming users are charged correctly.

IBM will provide computer platforms for wireless services such as Roaming.

8.0 SERVICE CREATION & MANAGEMENT (Figure 8)

8.1 CREATION

New services for wireless users should be quickly and easily created. This implies that services are defined within computer software that is standard and can be used by network operators to fulfill the service requests of their users. State-of-the-art programming techniques are available to enable programmers to write high-quality services software. Workstation computers have the requisite computing capacity for service creation.

Services software operates on standard, commercial-grade computer systems which we call a "database service node." Activation of a service is a simple matter of loading the service software into the computer and transmitting the service user's identification number to the MSC. Workstations are satisfactory for service execution.

8.2 MANAGEMENT

Service Management is an important function as it coordinates changes to the database service node computer files, service performance measurements, interfaces to other operational support systems, helps to ensure the integrity of the database service nodes, and restarts services after a recovered failure. The size of the services network determines the size and type of service management computer.

Intelligent Wireless Network

Cell Database

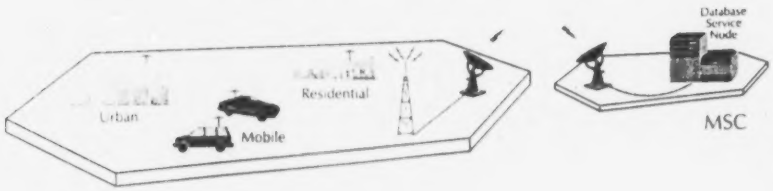

FIGURE 5

Intelligent Wireless Network

Wide-Area Database

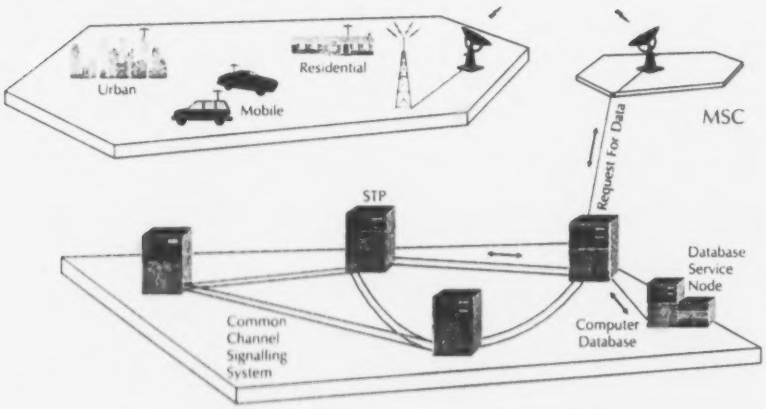

FIGURE 6

Intelligent Wireless Service

Roaming

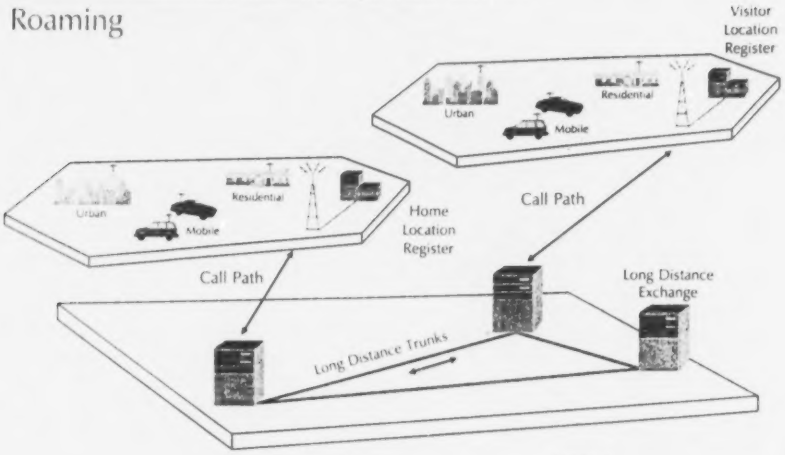

FIGURE 7

Intelligent Wireless Network

Service Creation And Management Systems

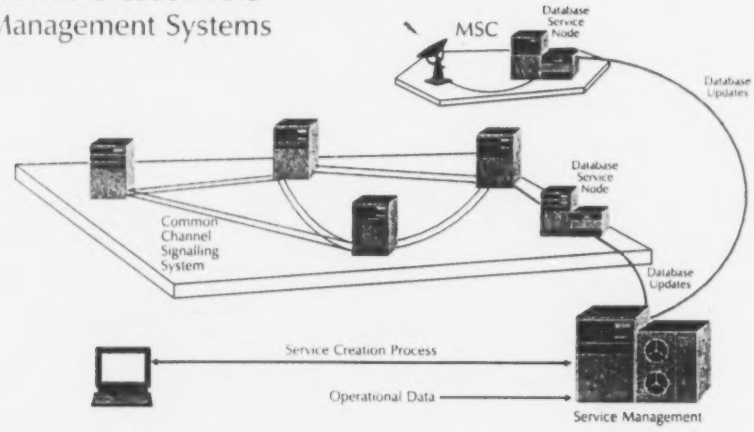

FIGURE 8

9 SUMMARY AND CONCLUSIONS

9.1 SUMMARY

The worldwide trends toward wireless are driven by an increasingly mobile society and the need to quickly activate telephones in countries that have very large backlogs of phone requests. Technology is split between analog and digital networks depending on the needs of the country and telecom agencies. Analog is less expensive but digital offers a greater range of services. Planning for wireless is expanding. Countries in the Americas, Europe and Asia are increasing their phone densities for social and commercial reasons. Wireless communications is a way to achieve this objective faster than with wireline networks.

9.2 CONCLUSIONS

Wireless communications have gained universal acceptability as an alternative telephone network. Although wireless connectivity is most important today, new standards and technology improvements will support the growth to new wireless services tomorrow.

New Customer Services Within the Intelligent Network

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ABSTRACT

The introduction of new, market-driven customer services within the Intelligent Network architecture is the subject matter of this presentation. Network operators worldwide see the Intelligent Network as the means to meet their customers' needs and to generate new revenues. The network operators have assessed their customers' requirements and are implementing the Intelligent Network to provide new customer services. In this presentation, I will describe some examples of the Intelligent Network services that are being introduced in Bell Atlantic as well as in the Asia/Pacific region.

1. INTRODUCTION

I would like to set the stage for a discussion of the new Intelligent Network services by first describing the motivation for telephone companies to implement the Intelligent Network. Then, I will review the fundamentals of the Intelligent Network so that we can begin a discussion from a common point. Next, I will summarize the five Intelligent Network services that Bell Atlantic plans to introduce into our network. Finally, I will describe the Intelligent Network services that Telecom New Zealand plans to have operational in 1992.

2. INTERNATIONAL TELECOMMUNICATIONS ENVIRONMENT

I would like to begin by discussing the motivation for implementing the intelligent Network.

I think clearly the one constant feature of the telecommunications environment is that it continues to change.

There are a number of factors influencing the PTTs:

Technology is advancing rapidly in the areas of digital switching, packet switching, fiber optic transport, access through the Integrated Services Digital Network, or ISDN, multiplexing, etc. Telephone companies have come to expect that, increasingly, there will be technological breakthroughs that will permit the transmission of more information across the network to their customers.

Furthermore, the forces of deregulation and privatization are touching nearly every telephone company in the world.

In addition, competition is growing at an unparalleled level. In some countries, licenses have been granted to companies to provide telecommunications services through separate networks that have enabled them to bypass existing telephone networks. Also, in many cases, the exchange equipment providers prove to be the telephone company's biggest competitors by providing switch capabilities in private branch exchanges.

Finally, the customer's requirements have become increasingly sophisticated. For example, through surveys, Bell Atlantic's customers have told us that they want advanced features such as:

- simultaneous voice and data
- higher quality services
- lower cost and improved utilization of services
- greater data speeds
- more network flexibility and customer control, and, most importantly,
- the ability to solve their business problems today.

To be successful, the telephone company must be responsive to these influences by deploying state-of-the-art technologies and by enhancing the network with new features, functions, and services.

The problem that the telephone company faces is the delay in implementing these new capabilities in the network. The amount of time required for local exchange vendors to develop and introduce new features and services into the exchanges can be up to five years from service conception to the actual deployment. This problem has been termed "the software bottleneck." I think it is fair to say that, in today's competitive environment, this is an unacceptable arrangement.

The telephone company requires a network architecture that is independent of the exchange vendor's development schedule.

3. INTELLIGENT NETWORK

Bell Atlantic International has had discussions with telephone companies throughout the world, and clearly they view the implementation of Intelligent Network as a major direction in the 1990s and beyond. They see the Intelligent Network as providing the infrastructure that will allow them to respond effectively to the existing and future needs of their customers.

Fundamentally, the Intelligent Network is a service control architecture that introduces data processing capabilities into the telephone network.

Within the Intelligent Network, there is a centralized data element called a Service Control Point or SCP. The SCP is the heart of the Intelligent Network. It is the repository of information about customers and the capabilities of the network. What is more important is the fact that the SCP contains call processing information in the form of service logic programs. In response to queries from specialized exchanges, service logic programs in the SCP provide directions on how to handle Intelligent Network calls.

Because the SCP is a centralized, general purpose computer, the telephone company can overcome the aforementioned software bottleneck. The telephone company can implement a new service in response to his customers' requirements by coding service application software that will reside in the SCP, rather than in each local exchange.

Essentially, when the local exchange needs to know how to process a call that uses the new service, the following sequence of events takes place:

- the local exchange formulates an inquiry message and sends it to the SCP (if the local exchange does not yet have the capability to create an inquiry message, it forwards the call to an exchange office that does),
- in turn, the SCP queries its databases and sends back instructions on how the call should be handled to the exchange, and
- in response to the instructions it receives from the SCP, the exchange processes the call.

This process occurs in milliseconds.

Now, I will describe the components of the Intelligent Network.

3.1 SERVICE SWITCHING POINT (SSP)

The Service Switching Point, or SSP, is the customer's gateway to the Intelligent Network. The SSP is an exchange with special capabilities. It performs the following functions:

- It recognizes calls that require special handling, that is, the SSP identifies pre-defined "triggers" that mark Intelligent Network calls, such as the "800" dialed digits in the United States.
- It formulates and transmits requests for instructions to the Service Control Point through the Common Channel Signaling Network
- Upon receipt of call processing instructions from the Service Control Point, it completes the call.

Through the efforts of Bellcore and the multi-vendor interaction, or MVI, process, modular and reusable capabilities are being defined for the SSP. These capabilities are the building blocks through which new services will be created.

3.2 SIGNALING TRANSFER POINT (STP)

The Signaling Transfer Point, or STP, is a packet switch that routes messages between network elements within the Common Channel Signaling Network. In the United States, the STP is part of the Common Channel Signaling Network using the Signaling System No. 7 protocol.

Using our example of a typical Intelligent Network call, the STP opens the packet containing the query for call processing instructions from the Service Switching Point. Then, the STP analyzes the query and forwards it to the appropriate Service Control Point and service application. This process is called Global Title Translation. Conversely, when the Service Control Point sends a response back to the Service Switching Point, the STP routes the packet back to the appropriate exchange office.

The STPs are installed in "mated pairs" to ensure continuous availability.

3.3 SERVICE CONTROL POINT (SCP)

As I mentioned earlier, the Service Control Point, or SCP, is the heart of the Intelligent Network. The SCP contains customer and network data as well as service applications. In response to the Service Switching Point's requests for information, the SCP sends call handling instructions to the Service Switching Point.

Today, Bell Atlantic has a mated pair of SCPs that were developed by Bellcore. The two SCPs are located in the Philadelphia, Pennsylvania area and serve the Bell Atlantic Region.

We are presently offering two service applications: 800 service and Alternate Billing Service, or Calling Card service. Bellcore developed these service applications.

Although these service applications are very profitable, they represent only the tip of the iceberg for the possible services that can be provided within the Intelligent Network. The next generation of Service Control Points will offer the telephone company the powerful tool of service creation.

Service creation is the ability of the telephone company to define and implement new services through the coding of service applications software. Service creation enables the introduction of services in a timely and economical manner, independent of the exchange vendors.

The promise of service creation will be fulfilled when two requisites have been met:

- the installation of Service Switching Points with modular, reusable call processing capabilities and
- the implementation of Service Control Points with service applications to direct the manner in which these capabilities are processed by the Service Switching Point.

Bell Atlantic is planning the development of a new Service Control Point. This Service Creation Point will provide a software platform and a service creation environment. Ultimately, this arrangement will move the development of new services from the exchange office vendor to the telephone company and to the customer.

Shortly, I will describe the five new service applications that Bell Atlantic plans to implement in its Intelligent Network.

3.4 SERVICE MANAGEMENT SYSTEM (SMS)

The Service Management System, or SMS, is the operations system for the Service Control Point and the 800 service application. The SMS contains a backup database for the Service Control Point, and it is through the SMS that changes are made to the Service Control Point.

Currently, Bell Atlantic and the other six Regional Companies share a national SMS for 800 service that is located in Kansas. Bell Atlantic has its own SMS for the Alternate Billing Service called DBAS, the Database Administration System.

3.5 SIGNALING ENGINEERING AND ADMINISTRATION SYSTEM (SEAS)

The Signaling Engineering and Administration System, or SEAS, is the operations system for the Common Channel Signaling Network. It provides a network view of the Common Channel Signaling Network and updates the routing tables in the signaling elements.

4. COMMON CHANNEL SIGNALING NETWORK

The Common Channel Signaling Network forms the foundation of the Intelligent Network. It is a packet-switched network that transfers messages between Intelligent Network elements, e.g., between Service Switching Points and Service Control Points, between Signaling Points, etc.

The Common Channel Signaling Network has enabled Bell Atlantic:

- to offer non-database services,
- to support the signaling for the Integrated Services Digital Network, or ISDN, and
- to introduce the database services of the Intelligent Network.

4.1 IQ SERVICES[SM]

The Common Channel Signaling Network architecture is the basis for a number of new services, which allow customers greater control over the calls they make and receive. These services have been tremendously successful in Bell Atlantic.

These new offerings are among Bell Atlantic's family of IQ Services. They use the attribute of the Common Channel Signaling Network through which the telephone number of the calling party, called the ANI (Automatic Number Identification) in the United States, is transmitted to the called party.

The new services are:

- Caller ID
  - Provides the called party a display of the calling telephone number on customer-provided equipment.

SM IQ Services is a service mark of Bell Atlantic.

- Call Block
  - Allows the customer to prevent completion of calls from specific telephone numbers.
- Return Call
  - Enables the customer to return the most recent incoming call automatically.
- Repeat Call
  - Redials busy numbers automatically.
  - When the called line becomes free, the telephone will ring, indicating that the redialed telephone number is ringing.
- Call Trace
  - Records the last call received and sends it to the telephone company.
- Priority Call
  - Provides a special ring for up to six important calling telephone numbers specified by the customer.
- Select Forward
  - Forwards up to six calling telephone numbers specified by the customer.

The penetration of these features has increased steadily in Bell Atlantic. The number of features deployed has grown from approximately 165,000 at the end of 1989 to a projected 784,000 at the end of 1991.

Overall, these services give customers the personal touch that they had in the past when all calls were handled by operators.

4.2 ISDN ARCHITECTURE

ISDN will provide the end-to-end digital connectivity that our customers require.

The Common Channel Signaling Network routes the D-channel signaling for ISDN.

4.3 JOINT STUDY ON THE INTELLIGENT NETWORK

As I mentioned earlier, the Intelligent Network will permit the rapid introduction of new services. To explore these possible services, a Joint Study on the Intelligent Network was conducted by Bell Atlantic, IBM, and Siemens beginning in 1988. The study dealt with the implications of introducing new services into the telephone network through the Intelligent Network architecture.

The three companies formed a number of study groups to explore the various dimensions of the Intelligent Network.

The results of the Joint Study were published in 1989 in the book, The Intelligent Network, which is now in its second printing.

5. NEW INTELLIGENT NETWORK SERVICES IN BELL ATLANTIC

Now, I would like to discuss some of the Intelligent Network services that Bell Atlantic is planning to introduce. Based on our successful offering of the IQ Services throughout Bell Atlantic, we are confident that the convenience and control provided by these new Intelligent Network services will be equally popular.

5.1 ABBREVIATED DIALING FOR MULTI-LOCATION BUSINESSES

This service provides Area Wide Centrex types of features for customers with multiple locations. Stated another way, this service gives the business customer private network types of features over the public switched telephone network. These features include:

- Individual numbering plans
- Directory number portability
- Extension dialing on a multiple exchange basis

The target market for this service is the business customer with multiple locations that are served by different exchanges

For example, suppose a company has two locations. If an employee at location 1 wants to contact his co-worker at location 2, he dials an abbreviated number.

A major advantage of this service is that each employee of the company can maintain the same telephone number even if the employee moves from a location served by another local exchange. Such a move requires an update to the Service Control Point to change the physical telephone number associated with the abbreviated telephone number.

5.2 AREA NUMBER CALLING

This service provides business customers with the ability to use a single telephone number for all

locations or branch offices. Area Number Calling would be particularly valuable to industries such as banking, insurance, retailing, real estate, and fast food, since these types of businesses use numerous branch offices or business locations.

The telephone company will have considerable flexibility in customizing the service for the individual customer. For example, the Area Number Calling service could automatically rout the customer to the closest business location based on the caller's telephone number, or ANI. Beyond geographic routing, the telephone company can provide call distribution by: information requested from calling party, time of day, day of week, date, call distribution among subscriber's location based on percentages, etc.

5.3 OUTGOING CALL SCREENING

This service provides customers with the ability to restrict outgoing calls to specific telephone numbers. For example, in the United States, customers dial numbers with a special prefix to reach sports information, jokes, adult messages, or prayers. They pay either by the call or by the length of the call. In some cases, children have dialed these numbers and have incurred large bills for their parents. Outgoing Call Screening service enables the customer to prevent unauthorized calls to the telephone numbers the customer specifies.

The target market for this service consists of business and residential customers who want to set call privileges to restrict access to certain numbers.

5.4 LOCAL OPINION POLLING

Local Opinion Polling provides for short duration, high-volume calling to media polling events as well as real-time polls conducted through television and radio broadcasts.

Through this service, the SCP collects polling information and forwards the results to a downstream system for tallying.

The target market for this service consists of information providers or data collectors that require calls or calling information to be routed to them.

The calls to the polling number can be interactive or non-interactive.

5.5 INCOMING CALL SCREENING

This service provides a set of features that can be used to establish and manage data connections between users and host computer systems, for example.

The service provides access verification for identifying and preventing unauthorized data users who attempt to access a host system. The network performs the screening of incoming calls. The subscriber determines the conditions for accessing data in the computer, including calling number, authorization code or PIN, time of day, day of week, etc.

The primary market for this service consists of database service providers.

A valuable feature of the Incoming Call Screening is that the Service Control Point could keep track of the telephone numbers of "hackers" that attempt to gain access to the host computer.

5.6 DATA AND REPORTS

This feature enables subscribers to receive raw data or formatted reports about the usage of the five network services previously described. Some examples of the information that could be collected include:

- Times of day that calls are made to a pizza location
- Amount of connect time to a host computer
- Directory number called for customers with Outgoing Call Screening
- PIN used in the attempt to access a host computer

The Service Control Point contains sampling and other special study functions that collect information on calls. Two methods of information collection could be:

- sampling a percentage of calls that use a service
- sampling all calls using a service with certain characteristics, for example, calls from a particular telephone number.

Data can be collected in real time and downloaded periodically to an external processor that assembles the data into reports for the customer.

The target markets for this feature would be: service providers, information providers, and corporate customers that need network management information.

6. TELECOM NEW ZEALAND INTELLIGENT NETWORK SERVICES

Telecom New Zealand plans for its Intelligent Network to be operational in 1992. The Intelligent Network will allow existing services such as 0800 and 0900 to be operated more efficiently but also will provide a number of new services.

6.1 ENHANCED 0800 AND 0900

Enhanced 0800 service will offer customers far greater flexibility and control over how their communications resources are operated and managed. Some additional features that will be available include: call diversion to selected answering points based on time of day, etc.; flexible billing based on volume or distance factors; call barring based on predefined thresholds. Similarly, the existing 0900 service will be enhanced through the Intelligent Network.

6.2 CALLING CARD SERVICES

Calling Card services allow toll calls to be billed to a specific number independent of the originating telephone number. The subscriber must enter the correct personal identification number on the telephone keypad, which is verified in the Intelligent Network database, before the call is completed.

6.3 TELEVOTING SERVICE

Televoting service totals the volume of calls made to certain numbers in response to a request for users to express their views, for example, on a particular issue. The service is often used by television public affairs programs in order to gauge public opinion on matters of current interest.

6.4 AREA WIDE CENTREX AND VIRTUAL PRIVATE NETWORKING

The Intelligent Network provides a platform to expand Centrex service from a local area to a national service so that a large company, for example, can present a single number for callers as well as provide an integrated, closely controlled network for internal communications. The resulting network is termed "virtual" because it appears to the users as if it were a completely separate entity from the public switched telephone network. As a result, the subscriber receives all the benefits of a private network without the expense.

7. CONCLUSIONS

To summarize, in an ever-changing, highly-competitive environment, telephone companies worldwide face the challenge of building a network infrastructure that will enable them to provide services to meet their customers' requirements.

Bell Atlantic believes that the Intelligent Network, with its service creation possibilities, is an integral part of the network of the future. We look forward with great enthusiasm to the implementation of the new Intelligent Network services in Bell Atlantic.

The Intelligent Network Joint Study that I described earlier provided a unique forum where Bell Atlantic, IBM, and Siemens could exchange ideas and learn together.

Bell Atlantic hopes to continue this dialogue with other telecommunications providers. By working together, we will realize the potential of the Information Age.

Development of Intelligent Network and Deployment of Advanced Services

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1. ABSTRACT

Telecommunications customers are continually seeking higher quality and more diversified services, as well as the ability to use these services at lower cost. To remain competitive and still satisfy customer requirements, NTT must provide more advanced services rapidly and efficiently. For these reasons, NTT has created a new network, a solid step forward towards what is now referred to as the "Intelligent Network Era." This report describes the NTT's Intelligent Network architecture, evolution, component technology, and implemented services.

2. INTELLIGENT NETWORK

2.1 OBJECTIVE

The major objectives to make the telecommunications network advanced and intelligent are the following two points.

(1)To satisfy the customer requirements
- -Low cost, high quality service
- -Diversified services
- -Customized service for each customer
- -Customer control of network management functions

(2)To satisfy the network operator requirement
- -Realizing diversified services
- -Rapid deployment of new services
- -Easy introduction of advanced technologies
- -Minimization of facility cost
- -Minimization of operation cost
- -High stability and reliability

Intelligent Network (IN) is a new network architecture which realizes the above customer and network operator requirements. Namely, Intelligent Network enables the network operator to provide a variety of network-wide services at lower cost to meet each customer expectation. Additionally, the wide area service operations will also become available to the network operator to improve the service quality.

2.2 BASIC NETWORK CONCEPT

In order to meet those requirements flexibly and effectively, it is very important to define a fundamental network architecture. Today, there is world-wide active discussion regarding Intelligent Network which can offer various services flexibly.

As shown in Figure 1, the basic network architecture is comprised of the following two broad layers.

(1)Transport Layer
- -Switching
- -Transmission
- -Real-time processing

(2)Intelligent Layer
- -Service and facilities control
- -Network management functions
- -Expandability due to function segmentation

3. TRANSITIONS OF SERVICE IMPLEMENTATION METHODS

The implemented services and the transitions of implementation methods are shown in Figure 2.

3.1 IMPLEMENTATION BY LOCAL SWITCH

The necessary functions to provide new services are implemented by hardware or software modification in local switches. For example, the services implemented by this means include Call Waiting, Three Way Call, and Call Forwarding, etc.

As the type of local switch software increases, the development of new services will become more expensive and require longer time. Also, as the number of local switches increases, the software or hardware modification will require more manpower to provide nation-wide services.

3.2 PRE-INTELLIGENT NETWORK

The necessary functions are integrated in specific toll switches. A call requesting the new service is routed to the specific toll switch and treated. This method is called pre-Intelligent Network architecture. The new services implemented by this method include initial Free Dial Service, Credit Call Service, and Facsimile Network Service, etc.

This architecture can considerably reduce the number of switches to be modified. Consequently, the problems above stated in case of the implementation by local switch can be resolved. However, the new problems come up such as new circuits need to be established between the local switches and the specific toll switches. More over, the optimum routing is not guaranteed because the calls requesting new services must be routed to the specific toll switch regardless of the final destination.

3.3 INTELLIGENT NETWORK

In order to overcome the problems in pre-Intelligent Network and to seek more effective architecture for future various services, Intelligent Network has been proposed and implemented. In this architecture, the advanced functions are separately implemented in intelligent nodes independent of actual switching nodes.

In NTT's Intelligent Network, there are two typical kinds of intelligent nodes: NSSP (Network Service Support Point) where network management functions such as database access and service management are implemented, and NSP (Network Service Control Point) where service control functions are implemented. As a result that each local switch accesses directly to NSP, the optimum routing is attained.

Intelligent Network enables a network operator to easily provide advanced services simultaneously in a nation-wide area. The new services implemented by Intelligent Network architecture are as follows:

-Free Dial Service (in service)
-Dial Q (in service)
-Credit Call (in service by pre-IN, planned to be changed to IN architecture)
-Closed User Group (awaiting service-in)
-Private Numbering Plan (awaiting service-in)
-Virtual Private Network (awaiting service-in)
-Mass Calling Service (under development)
-Personal Communications Service (under development)

4. INTELLIGENT NETWORK TECHNOLOGY

The technology required to create advanced telecommunications services can be divided to the following three major elements.

4.1 DIGITAL SWITCHING SYSTEM

-D70 (NTT's digital local switching system)
-Connection processing
-Service identification
-Access to NSP

4.2 COMMON CHANNEL SIGNALING No.7

-STP (Signal Transfer Point)
-ISUP (ISDN User Part)
-TCAP (Transaction Capability Application Part)

4.3 INTELLIGENT NODE

-NSSP
  Data base management
  Service specification compilation
  NSP management
  Customer Access management

-NSP
  Segmented functional part
  Real time service analysis and control
  Customer data management

5. BASIC NETWORK FUNCTIONS

It is very important to allocate strategically the segmented functions to network nodes for the rapid and flexible provision of advanced services. Those basic network functions are as follows:

-Dialed number conversion
-Charging
-Connection processing
-Network information transfer
-Customer control
-Network operation and management

6. CURRENT IMPLEMENTATION

The current NTT's Intelligent Network is shown in Figure 3. The intelligent nodes such as NSP and NSSP are completely independent of their locations. Therefore, they can give the flexibility and freedom to data allocation and operation.

In NTT's network, NSP has the access to the Traffic Control System (TCS). For example, NSP always counts the number of the busy subscriber lines of a certain customer, and compares it with the total number of subscriber lines. If all the lines are busy, NSP responds to the local switching system (GC) with the order of Busy Tone Treatment. If the number of calls to the same customer increases over the certain threshold level, NSP will judge as the congestion and report the event to TCS. As a response, TCS will send all GCs the order not to access the NSP for the service request of the concerned terminating customer. This traffic control enables the effective use of network facilities because of the reduction of invalid calls. It is also very important in order to protect the network from the peak traffic to a certain customer.

Presently, the new method of function allocation is under development to meet the demand of mass traffic such that telemarketing customers want to handle thousands of calls simultaneously. In the new Intelligent Network architecture, the necessary functions and customer data will be down-loaded from intelligent nodes to GC. After that, GC can handle those calls in the same manner as NSP. This new method will be able to release NSP from the congestion due to the access by mass traffic. As a result, considerably many calls can be handled at the same time.

7. SERVICE EXAMPLES

The major services implemented or under development using Intelligent Network architecture will be explained in terms of the following points.

-Transition from the existing analog network
-Administration of busy or vacant subscriber lines
-Mass traffic processing method
-Personal Telecommunications Service

8. TOWARDS FUTURE ENHANCEMENTS

The Intelligent Network and advanced services have been developed on the existing network. Therefore, there are still important issues to be solved for the future perfect Intelligent Network. The major issues are as follows:

-Customer Control
  Provision of "Tailor-made" customized services not "Ready-made" services
-Operation
  Provision of service operation and area-free operation
-Management and Administration
  Enhancement of billing processing
  Provision of ample traffic information

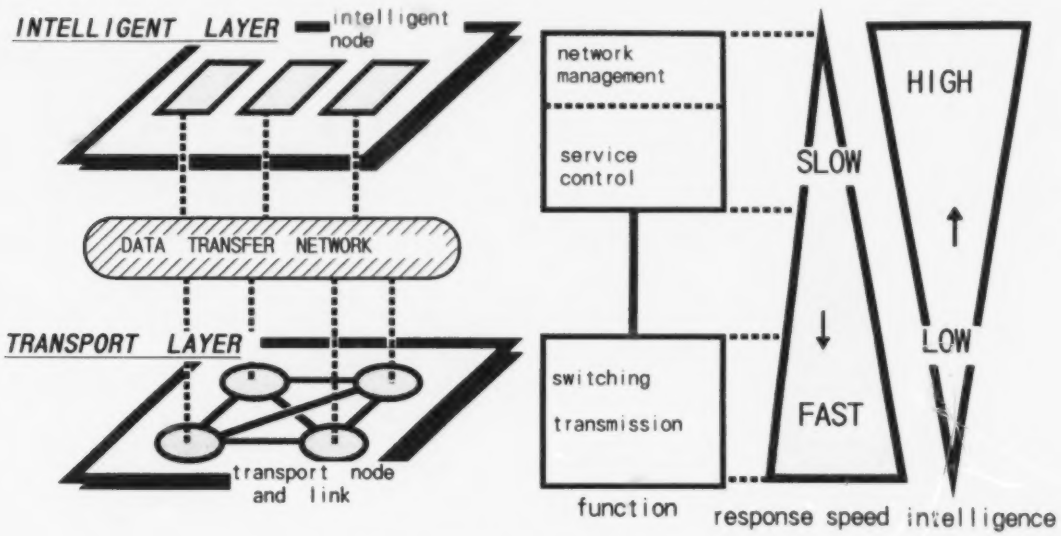

FIGURE 1. NETWORK ARCHITECTURE

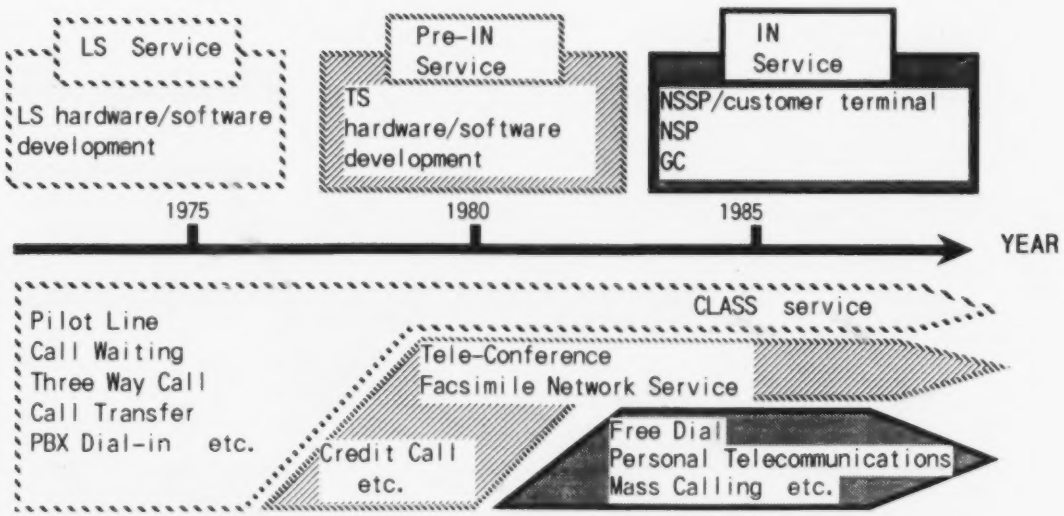

FIGURE 2. TRANSITION OF NETWORK SERVICES DEVELOPMENT

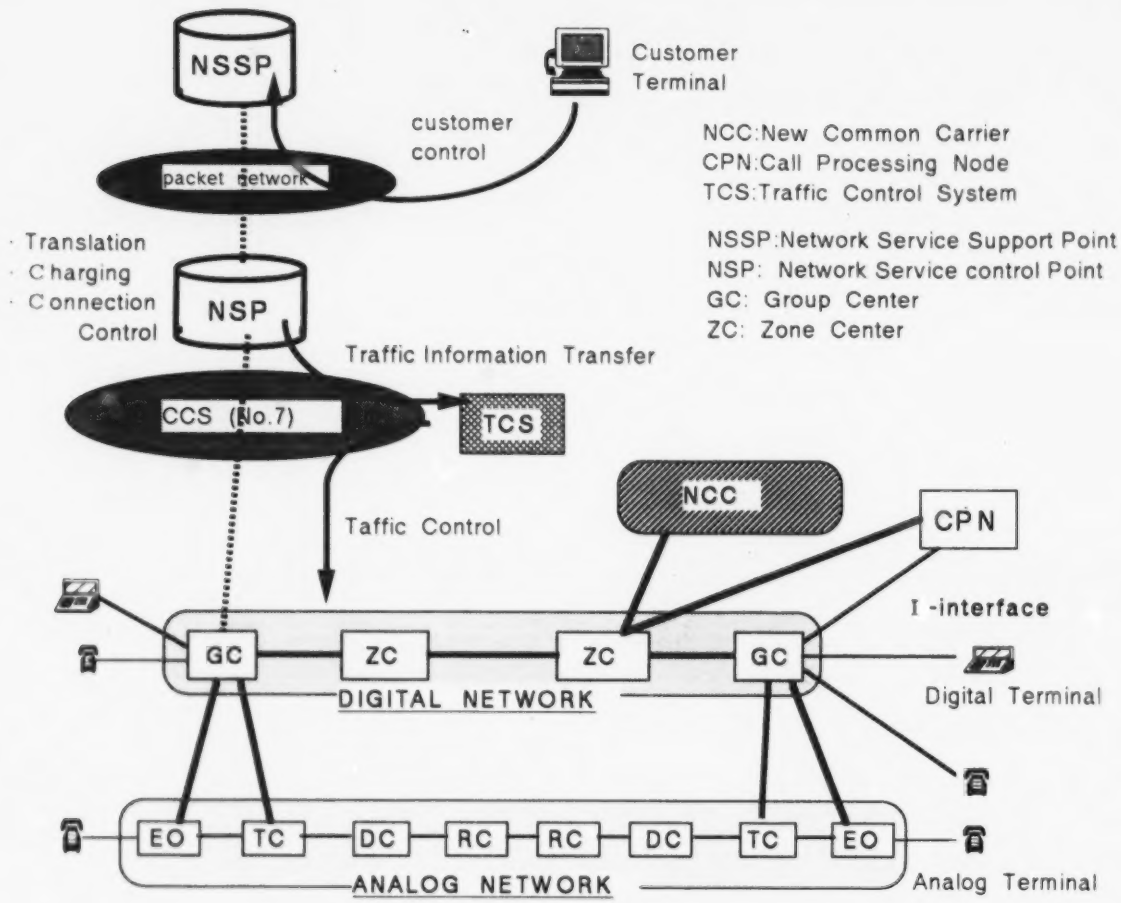

FIGURE 3. NTT INTELLIGENT NETWORK STRUCTURE

A Personal Secretary for Everyone

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1. Abstract

The combination of powerful personal computers and advanced modern telephone exchanges provides an opportunity to enhance personal telephone services through personal computer applications. In this paper we describe an exploratory system which enables a personal computer to be used to emulate a personal secretary in the handling of incoming calls for a knowledge worker. The paper provides an analysis of the role of a personal secretary and describes how the computer based system provides equivalent functionality.

2. Introduction

Businesses are continuously seeking ways of improving the productivity of their knowledge workers. Personal assistants or secretaries would help accomplish this goal, but this type of support staff has a high and recurring cost which increases each year.

The advent of the personal computer has greatly reduced the dependency upon support staff by enabling office workers to perform by themselves a number of functions which previously required the assistance of such staff. These include letter writing, filing, copying documents, mailing, business planning, and presentation preparation. (The computer-assisted incarnations of these functions are word processing, databases, laser printing, electronic mail, spreadsheets, and graphics programs.)

The "quantum leap" that the personal computer has brought to the workplace is now being expanded to include the telephony aspects of an office worker's job function. Despite many advances, there are still telephony functions which distract knowledge workers from their prime goals and with which a personal secretary can provide invaluable assistance. We have analysed these telephony related functions of a personal secretary and discovered that nearly all of them are within the capabilities of a typical personal computer and modern telephone exchange.

3. Enabling Technologies

It has long been recognised that a more powerful user interface would enable telephone users to gain increased utility from the powerful and complex features offered by a modern digital exchange. The use of a graphical user interface on a personal computer provides an attractive means of achieving this. Furthermore, personal computers provide the computational power, permanent storage, and access to peripheral devices that enables them to be the preferred platform for enhanced personal telephone services.

The powerful common channel signalling access offered to telephone users by modern exchanges makes possible the creation of a range of personal computer applications which offer the user flexibility and ease of use. The prime examples of this type of signalling are the D channel signalling protocols offered by the ISDN as well as many PABXs and key systems. In addition to basic telephone service, such protocols offer information about the calling party (calling line identification, or CLID) and allow the subscriber to control the disposition of the call through features such as call forward, transfer, and conference.

The implementation of telecommunications applications on the personal computer thus requires a means of connecting the D channel signalling on the exchange line to the computer. This connection requires custom hardware and software which is dependent upon both the architecture and interfaces of the computer and upon the protocols offered by the telephone exchange. The

hardware bridge may be provided by a plug-in board for personal computers (using the NuBus, MCA, ISA, EISA, or other buses) or through an external device which is connected to the personal computer via a standard data interface (such as SCSI, RS-422 or RS-232C). A block diagram of the latter configuration is shown in Figure 1.

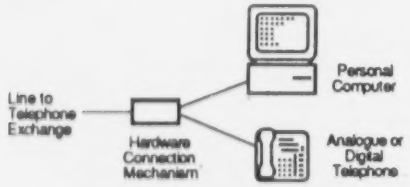

Figure 1: Connection Arrangements

Considerable additional value is achieved if this same connectivity mechanism is used to bring the ISDN B channels (or PABX equivalent) into the computer, since this broadens the range of the telecommunications applications that can be offered. First, it allows data communications applications to use the switched connections offered by the telephone network, and second it allows digitised voice to be brought in and out of the personal computer. The latter offers considerable value for telephony applications since it enables the application to play prompts to and record messages from callers. It also allows the telephone to be connected to the computer and to be used as a microphone and a private loudspeaker for a variety of multimedia applications.

Our research has shown that the computer system required to implement telecommunications oriented applications, such as the one emulating the functionality of a personal secretary, does not need to be particularly powerful. Interfacing with the D channel signalling protocol does not place stress even on low end computing systems, since an information rate as low as 300 bps will suffice. The most demanding requirement is bringing the voice stream into and out of the computer. The voice stream represents a relatively high information rate and must be read from and written to disk in real-time to avoid artificial constraints on the duration of the voice which may be played or recorded. Since current personal computer operating systems are not designed for real-time processing we have found this to be a demanding aspect of the software system design. Nevertheless, our research has shown that many current models of Apple Macintosh™ and IBM™ compatible computers are sufficiently powerful to execute B plus D channel applications in real-time.

4. The Secretary's Role

In a modern office, a typical secretary's job function includes much of the administrative and organisational work needed for the day-to-day running of the office. This may include requesting information or quotations from vendors, ordering and stocking of supplies, and maintaining schedules for visits and meetings. All of the above tasks require the use of a telephone.

Associated with these high-level job functions is a set of telephony related operations which are independent of the function itself. For example, answering a call, determining whom it is for, and transferring the call to the appropriate number is independent of what the call is about.

The secretary performs many of these telephony related operations on behalf of the knowledge worker. Since the secretary often does not need to know the reason for or contents of the call, these operations are open to automation on existing personal computers without the need for artificial intelligence techniques.

The operations performed by a secretary which involve a telephone can be usefully separated into incoming and outgoing call handling. We have concentrated our analysis on incoming call scenarios as computerised assistance with outgoing calling has already been developed into products such as Northern Telecom's *Meridian TeleCenter™* for the *Meridian 1™* PABX.

The purpose of having a secretary handle incoming calls is to allow the knowledge worker to concentrate on his/her work with a minimum of disruption. Based on instructions given to the secretary by the knowledge worker, the secretary decides how to handle each call.

The operations performed by a secretary on an incoming call always begin with:

- *Identifying the Caller*. This may be done via CLID display on the telephone, recognition of the caller's voice, the caller announcing his/her name, or the secretary asking who the caller is.

- *Screening the Call*. Based upon who the caller is and upon the current location and status of the

knowledge worker (for example, "in a planning meeting in room G17"), the secretary determines what further action to take.

Several possible actions may then be taken by the secretary:

- *Giving Information.* If the call can be handled by the secretary, such as when the call is from someone whom the knowledge worker has left information for but does not wish to speak with, then the secretary gives the caller the information and releases the call.

- *Transferring the Call.* If the call is best handled by someone other than the knowledge worker the call is transferred to the appropriate person or department.

- *Taking a Message.* If the knowledge worker is not available or does not wish to be disturbed the secretary takes a message.

- *Connecting the Call.* If the result of the screening is that the knowledge worker should be alerted to the call, the secretary puts the call through to the worker. The information collected during the screening process is often passed on to the knowledge worker.

A special type of incoming call occurs when the knowledge worker is away from the office and calls in to speak with his/her secretary. While some of the above actions are still valid, other actions may also be performed.

- *Delivering Messages.* The knowledge worker may ask to have new messages read to him/her by the secretary.

- *Dialling Numbers.* The secretary may dial a number for the knowledge worker and then connect the worker to the called line.

- *Updating the Worker's Location.* The knowledge worker may tell the secretary what his/her current location is so that future incoming calls may be connected to a telephone at that location.

- *Updating the Call Screening Rules.* The knowledge worker may also tell the secretary that he/she is now willing to accept calls for which messages were being taken, or that he/she is now busy and that more calls should be blocked.

5. The Computer as Secretary

Many knowledge workers have today a personal computer which sits on or beside their desks and which is for their exclusive use. Currently these computers run programs (such as word processors and spreadsheets) which perform actions only on the direct command of the knowledge worker.

As the speed and capacity of a typical personal computer increases it becomes practical for the computer to act as an agent on behalf of the knowledge worker. The earliest examples of this are electronic mail systems which collect mail and notify the knowledge worker of the existence of new, unread messages.

If the computer is connected to a telephone system with certain capabilities (see §3), then the computer may act as a personal secretary agent for the handling of incoming telephone calls.

5.1 Building a Secretary

Our approach to providing a personal secretary agent is to define a set of building blocks, called services, which correspond closely to the telephony operations discussed earlier. A *computer-secretary* is then a collection of services which are linked to one another so as to provide a sequence of actions which may be applied to a call. Any service may be linked to any other service, and some services may have several branches. A call transfer, for instance, may link to different services depending upon whether the line transferred to is busy, does not answer, or answers.

Collections of services may be organised into service profiles to be followed by the computer-secretary. Such profiles define the paths which may be taken by the secretary on each possible type of incoming call.

The knowledge worker, hereafter called the owner, may then configure his/her computer-secretary by creating service profiles. For example, a service profile for weekends may just direct all calls to a message taking service, whereas a profile for "do not disturb" during

working hours on weekdays may specify a more complex chain of services:

- If the owner's manager is calling, then ring the owner's telephone up to three times. If the owner does not answer, then take a message (with a special greeting for the manager) and release the call.
- Otherwise, transfer the call to a co-worker. If the co-worker is busy or does not answer, then take a message (with a general greeting) and release the call.

5.2 Services

The profiles can identify the caller, make screening decisions, and then give information, transfer the call, take a message, release the call, or connect the caller to the owner. If the caller *is* the owner, the computer-secretary may also deliver messages, dial numbers for the owner, and accept changes to its configuration.

5.2.1 Call or Caller Identification

Incoming calls may be identified in much the same way that a human secretary identifies the caller. If the exchange supports CLID for at least some calls, then this information may be used: If not, the computer-secretary may ask the caller for his/her name (if speaker identification software is available) or for a personal identification number (PIN) which the caller then enters via the DTMF keypad on his/her telephone. The latter two techniques are superior in that they identify the *caller* rather than the *telephone*, but they are also more obtrusive.

Whatever information is available may then be enhanced via searches of on-line directories. For example, if the CLID is known, a search of the organisation's on-line directory will produce the caller's name and department.

5.2.2 Call Screening

Screening consists of using the caller's identity, the called number (where the owner has more than one line), the day, date, and time, whether the incoming call is internal or external (for PABX implementations), plus any other instructions about the owner's status (such as "I'll be at lunch from noon until 2:00 PM today.") to make a decision on how to handle the call.

The result of the screening is that the call is linked to another service (or chain of services) which handles the call appropriately.

5.2.3 Announcements and Voice Menus

Two services which implement the secretary's role of providing information to callers are the ability to play announcements and the ability to provide a menu of choices to be selected by the caller. When combined, these services allow the computer-secretary to handle some types of calls entirely on its own.

An announcement is a pre-recorded message for callers. It may be used to tell callers when the owner will be available, the names of colleagues who may be able to help, a project status report, or any other information the owner wishes to make available.

A voice menu presents the caller with a list of choices which may be selected by entering DTMF digits. In this way a caller may be given a choice of services. If the services chosen by the caller do not include an attempt to connect to the owner, then the owner need not be involved in the call.

5.2.4 Call Transfer

This service transfers the call to another number. If the computer-secretary can detect that the number to be transferred to is busy or does not answer after a specified time, the call may be linked to another service. If the transfer is successfully completed the computer-secretary drops out of the call.

If the owner is at his/her desk the computer-secretary can ring the owner's telephone directly. Connection to the owner requires transferring the call if the owner is at a remote location.

5.2.5 Message Taking

Messages may be taken from the caller primarily by asking the caller to leave a voice message. The message may be recorded either directly onto the personal computer or onto an external voice mail system.

The former approach has the advantage of supporting a graphical view of the voice (for direct selection of the playback position) but also the disadvantage of using significant disk space on the owner's computer. Although the owner can specify an upper limit, the actual amount of space used is determined by the

callers in how long they talk and how often they call, rather than by the owner of the computer.

Recording messages onto an external voice mail system has advantages if there is already an existing system in place and if it is desirable to remotely retrieve messages even when the owner's computer has been turned off. In practice, it is believed that the two systems will complement one another.

5.2.6 Message Retrieval

If an external voice mail system is being used to store messages from callers, then the computer-secretary need not be involved in their retrieval. The owner would call the voice mail system directly.

If messages are being stored on the owner's computer and the caller has been identified as the owner (usually with considerable certainty through either voice recognition or a unique PIN) then message retrieval and other services may be made available.

Such message retrieval is essentially identical in its remote user interface to that of the external voice mail system. The main difference is that because it is integrated into the rest of the computer-secretary, other services may be used before and after message retrieval during the same call. (The *local* user interface would be quite different of course–a window with a list of messages which may be selected and played.)

5.2.7 Remote Dialling

Another service which is usually made available to just the owner is the ability to dial numbers from a remote telephone as though the secretary were placing a call for the caller. The computer-secretary accepts the number to be dialled through DTMF key-presses or through voice recognition. It then puts the caller on hold, dials the collected number, and if the call succeeds, joins the caller with the dialled line. The computer-secretary may drop out of the call at this point or may wait silently in the background until needed to perform other services.

Remote dialling, especially with enhancements for name dialling and for restricted access to toll trunks, is also useful as a general service for any caller. (Name dialling uses a directory to determine a number from a name, using the letters on the telephone keypad to spell out the name.)

5.2.8 Reconfiguration

A service which is always reserved exclusively for the owner is the ability to reconfigure the computer-secretary. Reconfiguration includes changes to the call screening rules and the ability to turn the computer-secretary off. The owner may also indicate his/her current location (that is, current telephone number) to the computer-secretary so that future calls may be connected to the owner at a remote location.

6. Computer-Secretary Advantages

The computer-secretary is intended for those knowledge workers who would not be provided with a human personal secretary because of the high cost. Any assistance with call handling is therefore an improvement for these workers. Additional advantages arise from the high availability of the computer-secretary and from the non-centralised nature of its administration.

Since a computer may be operating during nights, weekends, and other holidays, the services of the computer-secretary are always available. This universal availability can be used in novel ways, such as in a precursor to Universal Personal Telecommunications (UPT) services. The owner may use a single telephone number for all voice oriented communications, and the computer-secretary at that number can then find the owner. With the additional capability of remotely reconfiguring the computer-secretary, the total service being provided closely parallels the capabilities proposed for UPT.

Because our exploratory system is a personal one, centralised administration is not required. Although current PABXs provide some of the desired computer-secretary functionality through call forwarding, Direct Inward Service Access (for remote dialling), and voice mail, these functions require centralised purchasing and administration. A computer-secretary allows, for example, transfers which are more flexible than PABX based call forwarding (in that they may be chained in any order, and with separate actions for busy or non-answering extensions) yet allows all purchasing, configuration, and administration to be done by the owner without assistance.

In summary, our analysis of the telephony operations of a personal secretary has shown that most of these operations can be automated on typical personal computers. In organisations which cannot currently afford human secretaries for the majority of their knowledge workers, the computer-secretary may provide a cost effective solution.

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The Deployment of Fiber Optic Systems and The Technology

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1. ABSTRACT

The deployment of optical fiber systems and the technology required for this deployment are two of the most important issues confronting telecommunications carriers as they approach the 21st century. This paper will describe the FTTZ (Fiber To The Zone) part of NTT's nationwide deployment strategy. It will also introduce new technologies necessary for the realization of FTTO (Fiber To The Office), FTTZ and FTTH (Fiber To The Home). In addition, it will take a look at NTT's "Chiyoda Pilot Plant", a model plant employing optical access systems.

2. THE ROLE OF FIBER OPTIC SYSTEMS

In Japan, optical fiber systems are seen as a key step toward relieving Japan's heavily congested underground facilities. Fiber optic cables will also be installed in large newly developed areas, and will replace old crossbar switches in rural areas. Moreover, optical fiber systems are necessary to support growing user demand for such high-speed and broad-band services as high-speed digital leased circuit services.
NTT regards the deployment of optical fiber systems both as the foundation of Japan's future communications infrastructure and as the key to realizing NTT's service vision for the 21st century, which is based on providing Visual, Intelligent and Personal services. Accordingly, NTT is now introducing optical access systems into urban office buildings. This process, called Fiber To The Office (FTTO) is the first stage in NTT's deployment plan. The next stage, Fiber To The Zone (FTTZ), is being planned as an intermediate step to the third stage, Fiber To The Home (FTTH) and also to the FTTO in certain areas.

3. DEPLOYMENT OF OPTICAL FIBER SUBSCRIBER-LOOPS

The replacement of Japan's existing wire cable subscriber networks with optical fiber will evolve in various ways, depending on each area's characteristics. Several network deployment strategies have been devised, such as FTTO, FTTZ and FTTH, in order to make the complicated transition to optical fiber networks as smooth and cost effective as possible.

3.1 FTTO

In urban commercial areas, several types of Central Terminal/Remote Terminal (CT/RT) systems are now being introduced to big office buildings as a first step in the FTTO process. Newly constructed buildings are the main deployment targets in this first stage. In addition, FTTO includes introducing optical fiber to existing buildings to relieve the congestion in underground facilities and replace old metallic cables.

In order to accomplish a gradual expansion of fiber optic systems, the next FTTO step will be to provide optical access systems to medium and small-size buildings. Once FTTO has been accomplished, NTT will be able to provide not only low-speed services but also high-speed and broad-band services whereever demand appears.

3.2 FTTZ

In non-business and suburban residential areas, there is now little demand for FTTH, mainly because subscribers do not yet have a clear idea of what type of services will be available and what benefits will result. Although the hardware cost of optical fiber systems are generally more expensive than conventional metallic ones, installation costs are lower in some cases. For example, fiber optic cables can be installed in existing underground facilities relieving the congestion of metallic cables, while new tunnels would have to be built to house new metallic cables. Moreover, the installation of optical fiber systems in newly developed areas will be economical in the long run because subscribers are expected to increase rapidly in such areas. Thus, the introduction of optical fiber systems will result in reduced reconstruction costs and enhanced telecommunications networks, and will enable NTT to meet projected future demand for advanced services.
As a preliminary stage to FTTH, NTT plans to first promote the introduction of optical fiber systems to certain zones within an economically advantageous range, which is called FTTZ (Fiber To The Zone). Here, "Zone" means the area in which subscribers receive services through CT/RT systems. The number of subscribers in one "Zone" ranges from a few dozen to about 1000.
Under FTTZ, metallic cables are extended from an RT to a user, as shown in Figure 1. At present, NTT is planning the development of smaller-size RT systems which can be more economically implemented. Such RTs will result in the expansion of optical fiber to each floor of buildings and places close to subscriber homes. In this way, initial subscriber demand for B-ISDN services can be easily met by connecting a spare fiber to the existing optical fiber cables installed near user homes.

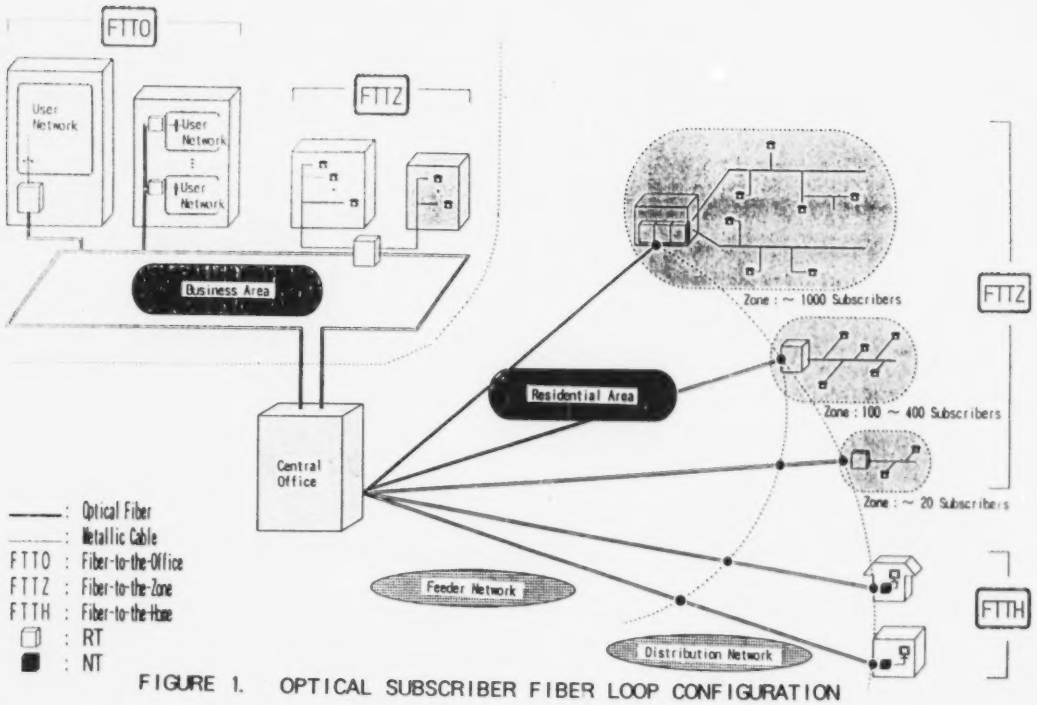

FIGURE 1. OPTICAL SUBSCRIBER FIBER LOOP CONFIGURATION

For FTTZ to be successful, it will be necessary to develop technologies that will enable RT systems to serve as platforms for supplying optical fiber systems to users. In particular, RT system installation must be more flexible, and service capacity must be expanded.
The deployment of optical fiber systems will follow several scenarios, depending on the characteristics of each area. Figure 2 shows NTT's deployment scenarios for optical fiber systems.

4. TECHNOLOGIES FOR OPTICAL FIBER SYSTEMS

NTT has developed a new CT/RT system and a Subscriber Line X-connect Module (LXM) system in order to realize a more economical and efficient introduction of FTTO and FTTZ.

4.1 NEW A/I-CT/RT SYSTEM

The new CT/RT system, as shown in Figure 3, can provide both analog telephone services and ISDN basic rate interface services using technologies established in the previous model. This system is both more compact and cost-effective than the previous one, and can be installed in user buildings and portable telephone offices.
Two system types have been developed with differing capacities. One type accommodates 100 subscribers and is installed in medium-size user buildings. The other handles 400, and is installed in large-size user buildings as well as portable telephone offices and boxes. Both types of RT systems consist of RT multiplex, testing equipment, subscriber-circuits, a power supply circuit and battery equipment.

These systems are mainly installed in the MDF rooms of user buildings. The 100-subscriber model sits in a cabinet measuring H700mm× W700mm × D450mm and is small enough to be set on the floor. It is powered by commercial AC100 Volts. If commercial power should fail, both systems can operate for up to three hours on their own battery power.

4.2 LXM SYSTEM

4.2.1 BACKGROUND

NTT's LXM system, currently under development, has been designed to help bring about the realization of FTTO and FTTZ, particularly in large-scale business areas. The LXM will help facilitate the deployment of optical access systems.
The LXM enables NTT to meet user demands, for example, by realizing efficient risk distribution. At present, most subscribers in large-scale buildings require risk distribution. That means each subscriber has to be accommodated by plural local switches. However, this has not always been possible, because plural RTs when set on a floor occupy a large space. In addition, users also wish to retain their telephone numbers when they move. In order to meet these requirements, each subscriber accommodated by one RT must be able to connect to whichever switch is available. The LXM makes this distribution possible. Moreover, the LXM also enables efficient use of switches. For example, some of ISDN subscribers are now accommodated by local switches (D70) which distribute them to ISMs (I Interface Subscriber

Module). Accordingly, the LXM will distribute ISDN subscribers directly to ISMs and save the accommodating capacity of DTOs.

4.2.2 CROSS-CONNECTING PER 64KB/S

The LXM's feature characteristic, the cross-connecting function, has a minimum cross-connecting unit of 1 time slot (64kb/s). This enables the LXM to handle cross-connecting for each subscriber.
NTT is developing the LXM with reference point V, which is the point between the optical access system and switch. The function of 64kb/s cross-connecting gives the LXM an inner-structure which is compatible with coming standardization of the reference point V. In addition, the LXM is able to cooperate with various kinds of testing signals, controling signals and ISDN interfaces by defining transmission formats. The 64kb/s cross-connecting makes the LXM flexible in terms of adapting to new interfaces.

4.2.3 LXM CHARACTERISTICS

The LXM will be located in an NTT central office and will be positioned between the RTs and local switches. Thus, subscribers accommodated by RTs will be connected to local switches through the LXM. Figure 4 shows the LXM characteristics.

(1) Distribution of Analog/ISDN subscribers
The new A/I-RT accommodates both analog and ISDN subscribers. The LXM divides them and distributes analog subscribers to DTO switches and ISDN subscribers to ISMs (I Interface Subscriber Modules).

(2) Distribution of subscribers to switch
LXM can distribute a subscriber to any local switch connected to it. This characteristic enables efficient risk distribution and allows subscribers who move within a defined area to retain the same telephone number.

(3) Operation systems interface
LXM is connected to operation systems through Op-LAN (OPeration-LAN) as well as other network equipment. And, with the LXM and the robot-controled MDF, telecommunications network operations will be more efficient. For example, operators can automatically and sequentially execute such operations as making a new subscriber telephone available.
NTT will introduce the LXM and other equipment at a big model plant and put them into service in the spring of 1993. Details of this plant are discussed in Chapter 5. NTT is also planning to develop a smaller LXM for smaller telephone offices in urban areas.

5 A Deployment Challenge

NTT is planning to establish a large-scale model plant with optical access systems including LXM. This plant will be put into commercial service to demonstrate how telecommunications services will develop in the 21st century. This will also provide a platform for future strategic NTT offices in which total operation systems and optical access systems will play important roles.
This chapter focuses particularly on the significance of introducing optical access systems. The technologies introduced in the plant will represent the key technologies for the promotion of FTTO and FTTZ.

5.1 Chiyoda Pilot Plant

NTT is now constructing the model plant, called the "Chiyoda Pilot Plant", at Chiyoda ward in Tokyo. This plant will replace the Chiyoda Plant Center, which now accommodates about 80,000 subscribers.
The Chiyoda area is Japan's main financial district and is one of the three biggest financial centers in the world. Accordingly, to remain competitive, there is a constant need in this area for the most modern and advanced telecommunications services. The Chiyoda Pilot Plant is expected to begin providing such services from the spring of 1993. This will lead to the following benefits.

(1) Establishment of a basic infrastructure for future optical fiber subscriber-loop systems.

(2)Higher quality telecommunications services including faster response to user demands.

(3)More efficient NTT management of telecommunications services

Initially, four courses of a loop-shaped optical cable will be installed, each formed by 1000 single-mode optical fibers. Then, by the year 2000, optical access systems will have been introduced into all of the approximately 110 office buildings in the area.
Almost all telecommunications equipment, except for subscriber-loops, will be assembled in the NTT center. This includes all switches, the LXM, the robot-controlled MDF, the Central Terminal, total operation systems and so on. Using these facilities, the Chiyoda Pilot Plant will provide a glimpse of Japan's future telecommunications infrastructure.

6 Conclusion

FTTO and FTTZ must be deployed in cooperation with existing systems. Before FTTO and FTTZ can be successfully realized, it will be necessary to develop a more economical optical access system and more efficient total operations systems.
New systems now under development, such as the LXM and the new CT/RT system, will become part of the basic infrastructure of FTTO and FTTZ. These new systems will be evaluated at the Chiyoda Pilot Plant. Experiences gained from the pilot plant will enable NTT to develop optical fiber subscriber-loop systems to assure the successful realization of FTTO and FTTH.

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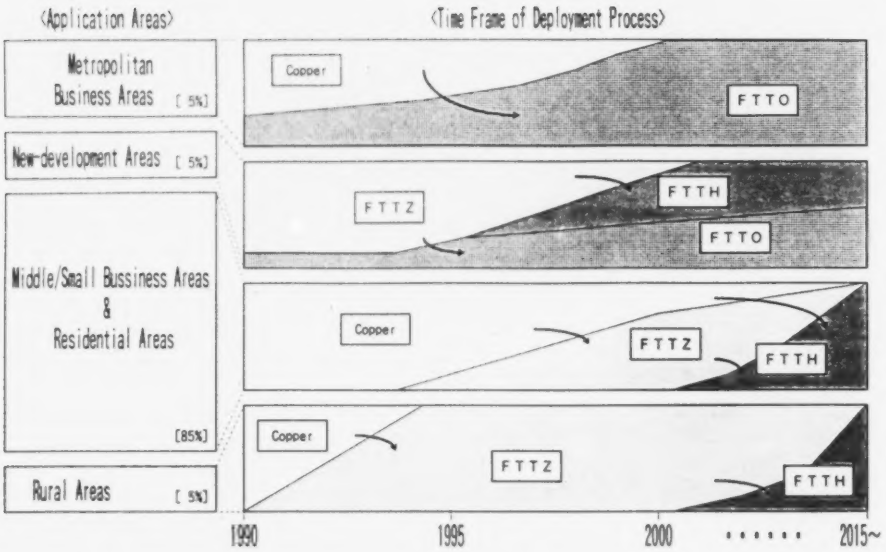

FIGURE 2. DEPLOYMENT PROCESS OF FIBER OPTIC SUBSCRIBER LOOPS

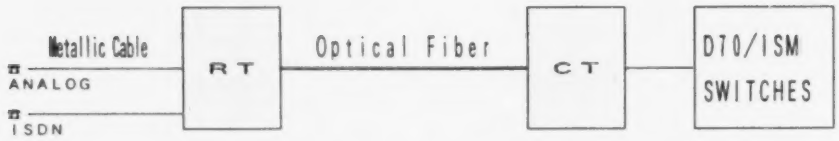

FIGURE 3. SYSTEM CONFIGURATION OF A/I- CT/RT

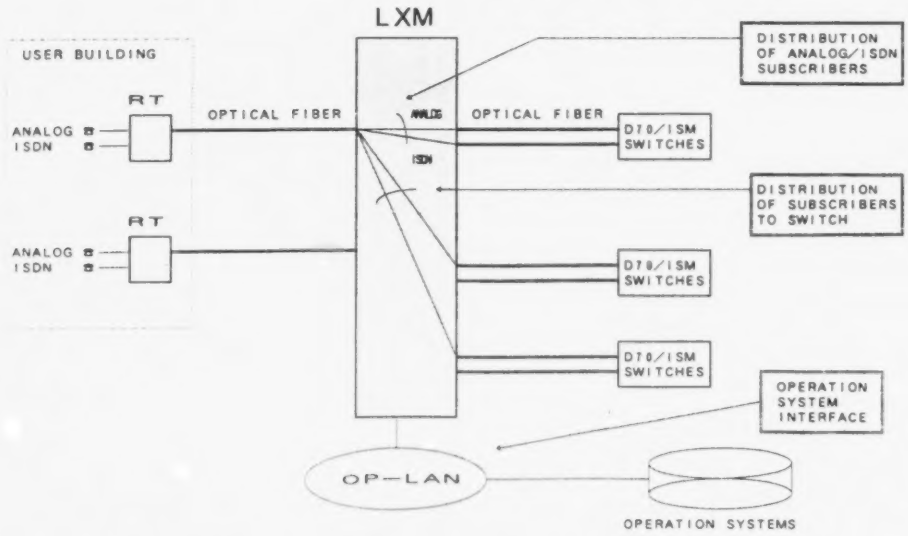

FIGURE 4. LXM CHARACTERISTICS

"VISTASAT"

An All Digital Small Earth Station For Rural Communication Services

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ABSTRACT

Rural development in Asia and the Pacific frequently depends on satellite communications networks to link villages to regional and national centers. The SSE "VISTASAT" earth station uses all digital transmission technologies which are superior to the older analog companded FM-SCPC systems and provides bandwidth and power efficiency that results in the user gaining access to lower cost "resource based" satellite tariffs.

1.0 Introduction

In the 1990's, reliable and highly interconnected telecommunications networks are recognized as one of the fundamental infrastructures needed to support a successful national economy. In newly developing countries, satellite communications is clearly the most cost-effective and fastest way to bring toll quality telecomms service to rural villages and remote subscribers. Because of critical cost and time considerations, satellite communications based telecommunications networks for international and domestic long distance service are being implemented in all parts of the globe.

The Pacific Rim in particular has seen a rapid rise in the application of satellite communications to meet network development needs. Throughout the ASEAN region, Indonesia's Palapa satellite system is successfully providing domestic and international telecom links and television service to cooperating countries. In Thailand, the government selected satellite communication over terrestrial systems to link rural villages to the national telephone network via ASIASAT. In adjacent Laos, the capital city of Vientian recently became linked to the switched international long distance network by eight INTELSAT "VISTA" Service circuits. Out in Oceania, the island nations of the Southwest Pacific, are now being linked by INTELSAT's "Super VISTA" Demand Assigned Multiple Access (DAMA) service to a full mesh network of domestic and international earth stations.

To facilitate the even wider useage of satellite communication networks, SSE Technologies has developed a low-cost, multi-channel digital earth station for use with the worlds commercial communications satellite systems. Called, the SSE "VISTASAT", this two-way satellite terminal uses an advanced microwave radiolink system , modular solid state electronic components and digital transmission technology to provide network operators with a versatile way to connect telephone trunks, synchronous data, or digital video for public switched or private line networks.

2.0 The VISTASAT Earth Station

SSE Technologies, Inc., the US manufacturer of Advanced Small Aperture Satellite terminals (called ASAT's), has developed an integrated satellite radio transceiver, digital modem/multiplexer package for use with "thin-route" network services like those offered by INTELSAT's VISTA and INTELNET Service tariffs. Dubbed "VISTASAT"®, this complete earth station package can supply toll quality digital voice, Group III fax and synchronous data communications via digital satellite circuits from 9.6 kbps to 64 Kbps. The SSE VISTASAT is designed for operations in point-to-point, STAR and Full Mesh networks.

2.1 Technical Description

The VISTASAT earth station was designed to take advantage of a number of convergent electronic technologies to produce systems that are highly reliable, low in cost, easy to install, maintain and operate. Importantly , they provide network operators with an all digital satellite terminal so as to take full advantage of the low priced "resource based " satellite tariffs being offered by INTELSAT and other satellite common carriers.

SSE Technologies accomplishes these design goals through the application of solid state devices in the Radio Frequency (RF) ASAT, by manufacturing it's earth station products in a modular package that enables graceful systems upgrades to higher power and data rates, by incorporating digital transmission technology for error correction and bandwidth compression, and by using small antennas with the RF terminal. The result is an integrated earth station system that provides the bandwidth and power efficiency needed in modern Single Channel Per Carrier (SCPC) satellite networks.

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The VISTASAT earth station is designed around SSE's standard ASAT RF product line. ASAT's incorporate Internally Matched Field Effect Transistors (IMFET) in the Solid State Power Amplifier (SSPA) providing highly stable power and gain with minimal intermodulation distortion. The ASAT downconverter incorporates low-noise High Electron Mobility Transistors (HEMT) as well as Gallium Arsenide Field Effect Transistors (GaAsFET) to provide a systems noise temperature as low as 45° Kelvin at C-Band and 160° Kelvin at Ku-Band. Frequency synthesizers are referenced to an ovenized 10 mHz. crystal oscillator providing fully synthesized frequency selection . Figure 2-1 shows the basic SSE ASAT consisting of a microwave "driver" unit (or transceiver, solid state power amplifier unit (SSPA), low noise block down converter (LNB), power supply unit(PS) and interconnecting cables.

The SSE ASAT operates in the following manner. On the transmit side, the RF driver upconverts a 70 or 140 mHz. Intermediate Frequency (IF) from the modulator to a radio frequency in the 5925-6425 mHz. (C-Band) or 12-14 mHz (Ku-Band). The transmitter configured for either fixed gain block or automatic level control (ALC) drives the solid state power amplifier with 8 dBm with the signal being amplified to the appropriate power output level (2, 4, 10, 20 watts at C-Band or 2, 4, 8 or 16 watts at Ku-Band) at the 1 dB compression point.

On the receive side of a C-Band system, the LNB downconverts the satellite downlink frequencies in a "block" to a L-Band frequency (1 gHz.) which is then fed to the RF driver unit for further downconversion. Downconversion modules include a transmit reject filter, a LNB and a downconverter module. The LNB is referenced to an agile synthesizer, and the downconverter is referenced to a Fixed Frequency Loop (FFL). See Figure 2-1 *ASAT Terminal Block Diagram.*

SSE ASAT's have been installed in 46 countries by systems integrators, PTT's and network service providers who typically have only purchased the ASAT RF package from SSE. The successful implementation of thousands of the SSE ASAT's have established the product as an industry standard.

In 1991, SSE began manufacturing digital satellite modems as a complement to the ASAT RF products. Integration of digital multiplexers and antennas quickly followed. Now a fully factory tested integrated earth station package consisting of an SSE ASAT with solid state power amplifier, SSE digital satellite modem, digital multiplexer and antenna are being supplied to customers. Factory systems integration insures compatibility of electronic interfaces and optimized transmission characteristics.

Requests by budget conscious customers for a "thin-route" earth station package resulted in the VISTASAT terminal products birth in early 1991. Designed with modularity and upward compatibility in mind, the VISTASAT follows with the SSE's "modular concept". This successful concept enables users of SSE ASAT's to upgrade to higher power levels without replacing the ASAT driver or LNB.

As an extension of this modular concept for the ASAT equipment, the possibility of producing fully integrated earth stations capable of being "grown" from a basic two location point-to-point network, to a STAR network cluster of ten to twenty sites handled through a "mini-hub", to a wide area full-mesh DAMA network of hundreds of sites, was seen as fundamental in furthering SSE's modular design concept. The VISTASAT was also designed so that networks could be developed around satellite tariffs that reward bandwidth and power efficient transmission systems with lower monthly channel rates.

Bandwidth and power efficiency are the two key factors with INTELSAT's VISTA and INTELNET service tariffs. With INTELSAT facing international competition from other satellite carriers, the worlds largest satellite network operator has initiated rewards to it's members with low-cost tariffs based on efficient use of the expensive satellite resource. This "resource based" utilization concept emphasizes use of technologies such as digital circuit multiplication and digital demand assignment of satellite channels to accomplish bandwidth efficiency. Use of voice activated, low-bit rate, digital modems for DAMA networks or "on hook/off hook" Pre-Assigned Multiple Access (PAMA) satellite circuits also conserves satellite transponder power.

First offered by INTELSAT in 1984 to stimulate satcom use by the less developed countries, VISTA Service provided an INTELSAT user with low monthly channels rates if companded FM-SCPC using 22.5 KHz.. bandwidths and voice activation were employed along with INTELSAT D1 category earth stations (6/4 gHz., 4.5 meter antenna, G/T of 22.7 dB/K). Because of the high costs of analog earth station products offered at the time, few VISTA circuits were ever actually put into service.

In 1989, the INTELSAT board reacting to members requests, agreed that 32 Kbps digital channels that occupy the same bandwidth as the old analog FM could instead be used in the VISTA Service. The SSE VISTASAT terminal fits the new specification for use in PAMA or DAMA SCPC applications as described in INTELSAT's VISTA and SUPER VISTA tariffs. As an example, a SSE VISTASAT station can carry four "toll quality" voice channels, "inband" modem traffic at 4.8 Kbps , synchronous data at 19.2 and Group III Fax. TV receive only capability can also be easily added. Cost per a single circuit are $445 per month for a preemptible channel or $780 per month for a non-preemptible channel, providing

an extremely economical way to bring telephone services to rural areas. Modular components and "low tech" equipment mounting kits enable a VISTASAT terminal to be installed on average in two days. See Figure 2-2 *An INTELSAT D1 Compliant VISTASAT.*

Recently, INTELSAT has suggested moving away from the VISTA Service tariffs because they have been under utilized. Instead, INTELSAT has been suggesting use of it's INTELNET tariff which allows for very flexible technical standards with no restrictions with respect to antenna size, G/T or modulation technique. INTELNET Service may be leased in bandwidth units from 100 kHz to 72 mHz. on either a full time or occassional use basis. Cost savings with the INTELNET service become readily apparent when a 3.8 meter antenna can be substituted for the 4.5 meter D1 compatible antenna as required by VISTA Service.

3.0 VISTASAT Networks

VISTASAT earth stations can be configured for point-to-point, STAR and full-mesh network topologies depending on the users requirement.

3.1 Point-to-Point and STAR Networks

In point-to-point or Star network application, the VISTASAT earth stations are linked using full-duplex satellite circuits. In a point-to-point network, two VISTASAT stations are linked by a pre-assigned circuit and generally each stations is of equal antenna size and configuration. In a STAR network configuration, network heirarchy becomes a factor as the hub station in a STAR network uses a larger antenna and often higher power transmitters than the remote sites. Transmission between the remote and a hub can be at various data rates ranging from 9.6 Kbps, 16 Kbps ,32 Kbps or 64 Kbps. Even at these slow data rates, micro digital circuit multiplex systems (MDCMS) in the VISTASAT can derive and transport multiple voice channels, Group III Fax and carry inband data up to 4800 Bps. To obtain power conservation on the satellite transponder, the VISTASAT digital multiplexer employs an "on hook/off hook" feature which only activates the RF carrier when an incoming call is connected to the input side of the mux. When the call is completed the circuit is placed back "on hook" and the carrier returned to an idle condition. While not as power efficient as voice activated demand assignment techniques, this method still results in reduced power consumption on the satellite transponder.

STAR networks using VISTASAT terminals configured as described are ideal for "thin-route" applications such as linking remote villages, mining camps or oil platforms into the switched network often through a so called"mini-hub". Mini hubs are useful as a start-up to a more highly interconnected network topology like demand assignment and can fullfill basic network requirements without large investments in master stations. A typical mini-hub can consist of up to 20 circuits, with each channel permanently assigned to a corresponding VISTASAT terminal. See Figure 3-1 *VISTASAT STAR Network.*

Examples of SSE VISTASAT terminals in STAR networks can be seen world wide. In Europe, they are being used by PTT's to bypass obsolete terrestrial networks left behind by the former Communist operators. In northern Europe they are in service linking North Sea oil rigs to the UK telephone network and in Latin America for a variety of corporate, scientific and government applications.

In Thailand, Indonesia and China, VISTASAT terminals are used in STAR network applications by PTT's and government agencies who, without adequate terrestrial network access, are using ASIASAT and the Palapa satellites to link villages to regional commercial centers. These rapidly developing countries have recognized the benefits of the ease in deployment of VISTASAT's, and the major cost savings over attempting to build expensive terrestrial cable or microwave networks. In the developing world where long system procurement lead times are common and capital budgets limited, many government telephone administrations have decided that they can't wait for fiber optics or ISDN technologies to become affordable. STAR networks using communication satellite technologies are fast becoming the low-cost option to connecting groups of rural subscribers and remote sites into the PSTN.

4.0 Full-Mesh DAMA Networks

When traffic grows in a network, or as more locations are added, the need to move from a STAR network to a "Full Mesh" Demand Assigned Multiple Access (DAMA) network may become an operational requirement. With a full-mesh network any station can connect to any other station through a limited channel pool allocated on demand by a master control station. With DAMA, a Public Telephone administration or private network operator gains tremendous efficiency in the reuse of satellite channels that are shared by a large number of sites. Since channels are assigned on demand as needed, DAMA eliminates the inefficiency of PAMA circuits which may only be used a fraction of the time. DAMA instead concentrates traffic onto a much smaller number of pooled channel resources minimizing bandwidth and using less transponder power.

For DAMA network applications, VISTASAT terminals can be combined with an appropriate DAMA master station controller, digital 16 Kbps modems and remote DAMA contollers to meet the needs of the largest national DOMSAT network. VISTASAT's are now being used in

DAMA networks applications in Europe, and the Far East provided to users by large system integrators and aerospace companies. Using INTELSAT's "Super VISTA" tariffs a network operator can establish a full mesh network for as little as $445 per circuit per month with as few as five circuits being used to link 20 locations depending on traffic. See Figure 4-1 *VISTASAT DAMA Network*

5.0 Model For a Point-to-Point VISTASAT Network

As a network planning tool, it is always necessary to undertake a satellite link budget calculation to determin the satellites EIRP, G/T and Flux density of the downlink signal coming from the satellite in space (the space segment) and the corresponding earth station (the ground segment). When calculated the size of the earth station antenna, power amplifier and noise temperature of the receiver can be made. Assuming the use of INTELSAT V at 174° east, the hemi C-band beam, a point-to-point circuit from the US territory in Guam to Honolulu operating at 32 Kbps rate would require only a 4.5 meter antenna and a 4 watt SSPA. Each VISTASAT terminal would cost less than $50,000 and be capable of carrying four toll quality voice channels. The monthly circuit charge from INTELSAT would be around $500.

6.0 Model For a Star VISTASAT Network

A cost model for a thin-route star network can also easily be developed. This cost model assumes that the network will use INTELSAT V located at 174° east, operate at 32 Kbps and connect nine islands in Micronesia with Hawaii. The satellite link budget indicates that on the hemi-beam, a hub station with a 4.5 meter antenna and a 20 watt SSE ASAT N406 equipped with IF combiner nine digital modems and multiplexer could be used and cost under $150,000. At the remotes in Micronesia, the VISTASAT's would be the same size and power as used in the point to point model. 32 voice channels could be supported between Hawaii and the island locations with "dial tone" being extended from the PSTN in Honolulu.

7.0 Model For a Full-Mesh DAMA VISTASAT Network

If a true Pacific wide multi-site network was to be designed, then DAMA technology would provide the greatest efficiency in terms of satellite channels requirements and earth station costs. In this model, the network will provide the entire Pacific Ocean Region with point-to-point full-mesh capability with high quality, digital, vocoded voice service under the control of a network master station on the Island of Oahu, Hawaii. The master station will comprise a 4.5 meter diameter antenna with the necessary transmission, echo control and DAMA electronics. All of the remote stations will consist of 3.8 meter antennas with similar electronics. The system will be designed for Grade of Service P=0.01. Network operation will utilize the INTELSAT global beam satellite space segment of the IS VA satellite at 177° east. INTELSAT provides the only space segment with global coverage currently available in the POR. However plans by PanAmSat and TongaSat may provide future alternatives. Global coverage must be used for the DAMA point-to-point (remote to remote) to avoid double-hop connections. In this model, 10 satellite channels at $500 each per month would link at least 20 locations across the Pacific with toll quality voice. The master station would cost approximately $250,000 with each remote at under $75,000. If 7000 call minutes per day were carried by the network at a cost of 1.50 per minute, a rapid payback and return on investment for this network would be possible in less than one year.

8.0 Summary

Decades of success stories in developing countries attest to the value of having a reliable national telephone network to support nation building and economic development. To expidite telecomms deployment, public telephone administrations through out the world now recognize satellite communications as the quickest and lowest cost way to bring high quality telecommunications to unserved locations. SSE Technologies, Inc. a pioneer in the development and manufacture of small aperture terminals for voice, data and video is now offering a new version of it's Advanced Small Aperture Terminal (ASAT) optimized for use in digital "thin-route" satellite networks.

The SSE VISTASAT earth station terminal is designed for network operators looking for a fast and cost effective way to bring service to rural and remote areas. Designed as a modular package, the VISTASAT can be configured for a single point-to-point circuit or for use in a network of hundreds of locations. Making use of digital technology and solid state power amplifiers, the VISTASAT provides a user with high reliability, multi-channel capacity at an affordable package price. It also maximizes methods to improve the efficiency of the satellite transponder by using bandwidth compression and power conservation. With the newly advanced "resource based" tariffs by INTELSAT and other satellite carriers now serving the Pacific Ocean region, a satellite based network using SSE VISTASAT digital earth stations can be gracefully and economically expanded as network traffic and topology grows.

Figure 1-1 SSE ASAT Block Diagram

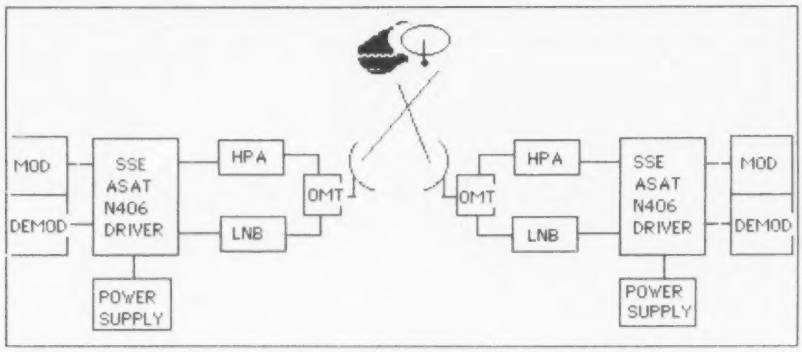
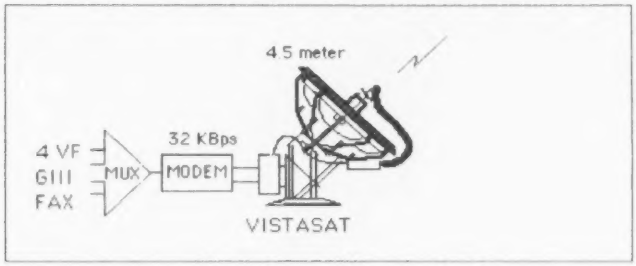


Figure 2-1 An INTELSAT D1 Compliant VISTASAT



Figuré 3-1 VISTASAT STAR Network

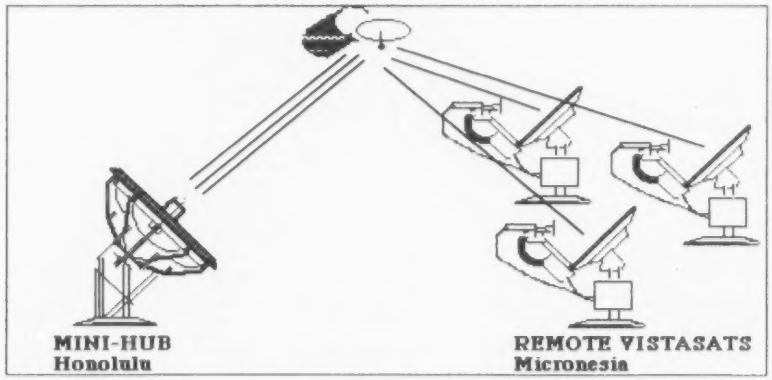
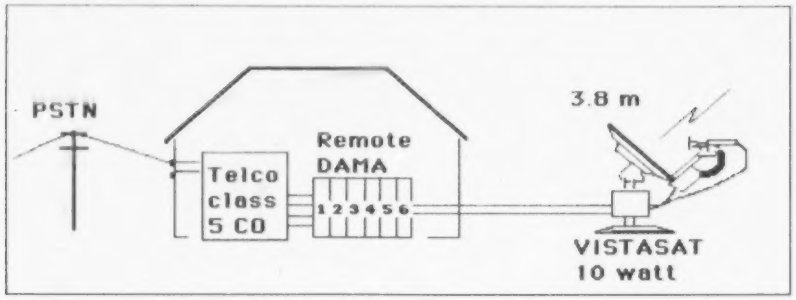


Figure 4-1 VISTASAT DAMA Network



A STUDY ON FEASIBILITY OF MOBILE SATELLITE COMMUNICATION SYSTEMS

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1. ABSTRACT

A concept study was conducted on feasibility of mobile satellite communication systems using the voice codec developed for digital mobile telephone systems. The conclusion seems to be positive.

2. INTRODUCTION

Though mobile telephones have been prevailing significantly, the ground based systems require many base stations and not cost effective in the area where traffic is thin.

In Japan, almost 70% of area has not been serviced. They cover main city areas, trunk roads, so the majority of communication needs of cars are satisfied.

But needs of long range trucks and cars for construction, disaster prevention and security in rural area are not fulfilled enough.

To complement ground mobile communication systems, services using satellites are expected.

Besides cars, boats and rural fixed stations will be served by satellite systems.

Already a low rate message communication system using existing Ku band transponders is servicing in US (Omni TRUCKS).

Satellites with dedicated transponders for mobile communication including voice services will be launched in coming years (Australia, Canada, US and Japan).

In Asia and Pacific region, there are many countries having vast area and it seems that the needs for mobile satellite communication systems will be strong.

Recently, development efforts of low bit rate voice codecs have been conducted extensively and compression technologies having sufficient quality for practical use are being achieved.

A study on feasibility of mobile satellite communication systems using these codecs is shown hereafter.

3. TREND OF VOICE CODEC TECHNOLOGIES[1]

To transmit voice signals in usual telephone quality, a 64 kbps bit rate by amplitude companding and 8 bits PCM is required. But lower bit rates are realized eliminating redundancies of voice signals and the auditory sense. The measures will be categorized in following three methods.

(1) WAVE FORM CODING
Wave forms are kept as much as possible in lower bit rates.

(2) ANALYSIS and SYNTHESIS CODING
Voice consists of voiced sounds which are generated by the vibration of vocal chords and voice-less sounds, by the turbulent flow. Identification of voice sources and voice spectrum are multiplexed and transmitted. In the receiving side, those two informations are demultiplexed and the voice signals are regenerated using a synthetic filter. This is called VOCODER and low bit rates are realized with rather low quality.

(3) HYBRID CODING
Two methods above are combined and fairly good quality is achieved at the bit rate around 10 kbps.

Voice quality of various coding methods is shown roughly on Fig. 1.
Usually MOS (Mean Opinion Score) which is a five level subjective criteria by many hearers is used to show the voice quality.

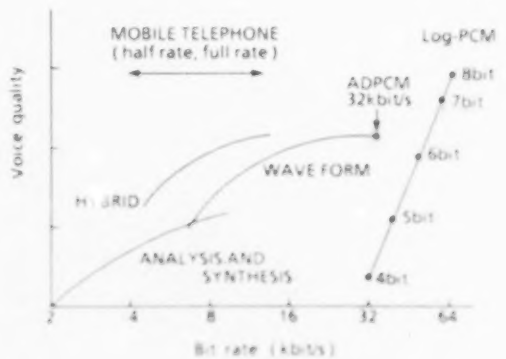

FIG. 1 VOICE QUALITY OF CODEC

VSELP (Vector Sum Excited Linear Prediction) which is a kind of hybrid coding was selected for Japanese mobile telephone systems.

(Voice information	6.7 kbps
(Error correction	4.5 kbps
Total	11.2 kbps

The codec has MOS 3.0 quality at 1% bit error rate [2]. As the next generation, half rate codecs are being developed. Within 1992, the half rate codec for US market will have been developed which has the following rates.

Voice information	4.5 kbps
Error correction	2.0 kbps
Total	6.5 kbps

A block diagram of a voice codec is shown in Fig. 2.

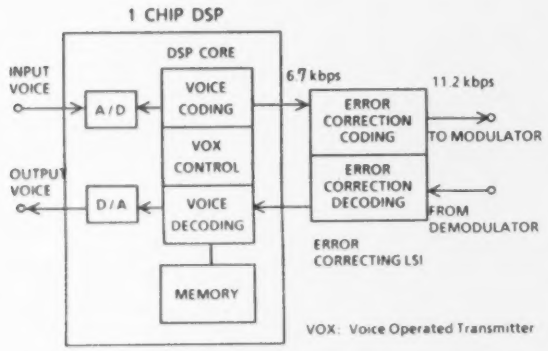

FIG. 2 BLOCK DIAGRAM OF VOICE CODEC

4. SYSTEM STUDY

A total system configuration is shown on Fig. 3.

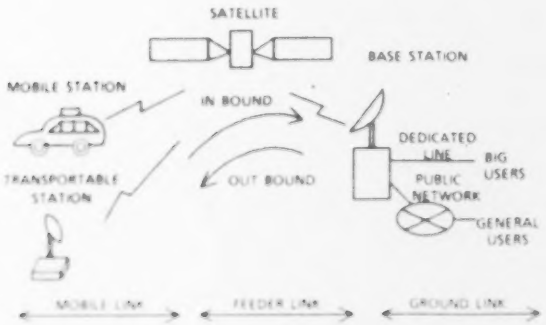

FIG. 3 CONFIGURATION OF MOBILE SATELLITE COMMUNICATION SYSTEM

Big users may use dedicated lines to access base stations. In some cases they will even own base stations. General users will use public networks. The inbound and outbound circuit between a base station and a mobile or transportable station consists a duplex circuit.

In this configuration a communication link between mobile or transportable stations has to pass a base station which means the link will path the satellite twice (2 hops).

This will cause about 0.5 second delay and quality degradations. In this study, only one hop communications are considered (if necessary, two hop communications are realizable though).

When the distance between a user and a base station is large, the ground link expense is high. Then some numbers of base stations will be required to cover wide area.

The ground link expenses will be lowered by multiplexed transmissions of compressed digital voices.

4.1 MOBILE LINK

This is the link between a mobile/transportable station and a satellite. A high gain satellite antenna is required to make a mobile station small.

The high gain satellite antenna leads to narrow antenna beams. This requires multi-beams to cover wide areas.

The multi-beam coverages are easily realized by a multi-port amplifier (MPA) as stated later. The allocated frequencies for mobile satellite communications are L band (1.6/1.5 GHz) globally and S band (2.6/2.5GHz) in the third region (Asia and Oceania).

In this study, S band is assumed avoiding marginal global requirements.

4.2 FEEDER LINK

This is the link between a base station and a satellite. A broader beam satellite antenna will be used for the feeder link because size constraints are not servere for base stations.

The C band frequency is selected as the lowest rain attenuation from C, Ku and Ka bands for fixed satellite communications.

4.3 COMMUNICATION METHODS

A digital communication scheme is selected using the codec which is developed for the ground digital mobile telephone systems.

TDM (Time Division Multiplex) and SCPC (Single Channel Per Carrier) are candidates for multiplexing. In the case of TDM, all earth stations (mobile, transportable and base) have to keep very strict synchronization.

As the frequency width and number of transponders are limited with the mobile satellite communication systems, a transponder may have to be used for various applications.

TDM might constraint the freedom of applications.

In this study the SCPC multiplexing is selected to allow various system configurations in a transponder.

As modulation schemes, BPSK (Bi-Phase Shift Keying) and QPSK (Quadrature Phase Shift Keying) are popular and shall be selected considering effective utilization of frequencies and the ground flux density limitation of a satellite radiated power to avoid interference to the ground radio systems.

The QPSK is selected for this study.

VA (Voice activation) is adopted for outbound circuits to increase the transponder capacity under the power limited condition. The inbound C band transponder has sufficient power and VA is not required.

5. CONSIDERATIONS ON SATELLITE

The EIRP of the MSAT of AMSC and TMI is as high as 55dBW. We assume similar order of EIRP as "state of art".

Following S band parameters are used in our study.

Diameter of antenna	: 3m
Antenna beam width	: 3 degree
Number of beams	: 12 (Fig.4)
Output power of MPA[3]	: 200 W
EIRP (Effective Isotropic Radiated Power)	: 53 dBW
G/T (Antenna Gain/Noise Temperture)	: 5 dB/K

The band width of each beam must be large enough to the required maximum channels of the beam during the satellite life.

The feeder link band width is equal to the sum of band width of each beam.

FIG. 4 MOBILE LINK BEAM COVERAGES
(The coverages are drawn rather arbitrarily)

A base station frequency band is divided for each S band beams. They are converted to a common frequency band and combind by hybrid circuits. All SSPA's have the same inputs and the outputs are devided again separating signals for each S band beams. (SSPA: Solid State Power Amplifier) The MPA has flexibility of traffic allocations for S band beams and partial failures of SSPA's are not critical for any beam.

The feeder link C band parameters are not critical and assumed rather arbitrarily as follows.

Transponder EIRP	: 30 dBW
G/T	: -7^{o} K

The C band antenna may have single or a few beams and beam shapes are not studied yet.

The satellite out bound link is configured as Fig. 5 and in bound link, Fig. 6.

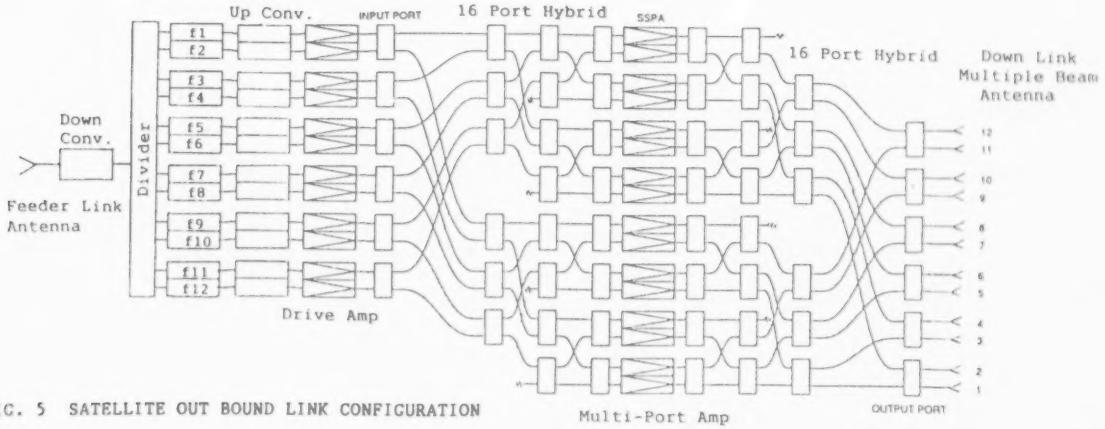

FIG. 5 SATELLITE OUT BOUND LINK CONFIGURATION

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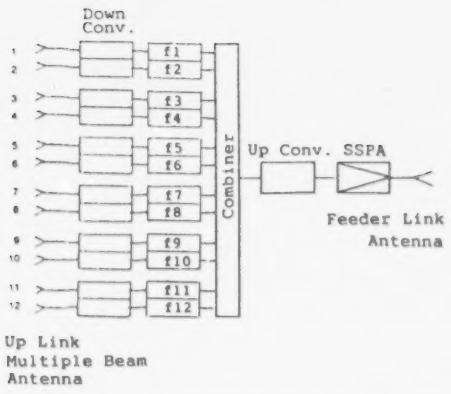

FIG. 6 SATELLITE IN BOUND LINK CONFIGURATION

6. STUDY ON EARTH STATIONS

6.1 MOBILE STATION

A mobile station is to be installed on an automobile, a train or a small ship. To increase the transponder capacity, a satellite tracking directional antenna is used. To decrease out door profile, a flat dic antenna shown in Fig. 7 is selected.

A block diagram of the mobile station is shown in Fig. 8 and major parameters in Table 2.

Table 2. Major parameters of mobile station

Frequency	: S band
Antenna	: steerable phased array, 0.5m diameter, gain 13 dB
Transmitter	: 5W SSPA
G/T	: -11 dB/K
EIRP	: 20 dBW

6.2 TRANSPORTABLE STATION

A temporaly and emergency use transportable earth station is similar with the mobile station except the antenna which is a fixed directional one. The major parameters are shown in Table 3.

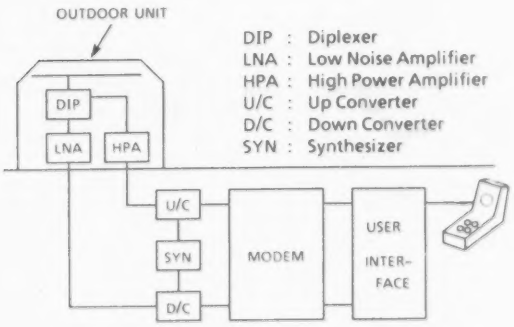

FIG. 8 BLOCK DIAGRAM OF MOBILE STATION

Table 3 Major parameters of transportable station

Frequency	: S band
Antenna	: meshed parabolic dish of 0.8m diameter (gain = 23 dB)
Transmitter	: 5W SSPA
EIRP	: 30 dBW
G/T	: -2 dB/K

6.3 BASE STATION

It is a popular earth station for fixed satellite communications.

Channel assignment functions using common signaling channels are required. Major parameters of a base station is shown in Table 4 in case of 250 channel capacity.

Table 4 Major parameters of base station

Frequency	: C band
Antenna	: parabolic dish of 5m diameter (gain = 48 dB)
Transmitter	: 20W SSPA
EIRP	: 61 dBW
G/T	: 24 dB/K
Capacity	: 250 channels

6.4 LINK BUDGET

An approximate link budget of the mobile link is given in Table 5. The feeder link budget is omitted because it is not critical.

Table 5 Link Budget of mobile link

item	mobile	transportable
SATELLITE		
EIRP (dBW)	53	53
BACK OFF (dB)	2	2
PATH LOSS (dB)	191.9	191.9
MOBILE/TRANSPORTABLE		
G/T (dB/K)	-11	-2
DOWN LINK C/No (dBHz)	76.7	85.7
MARGIN (dB)	2	2
REQ'D C/No (dBHz)	full: 46.8 half: 44.4	full: 46.8 half: 44.4
TPDR CAPACITY (ch)	full: 980 half: 1700	full: 7760* half:13490*
MOBILE/TRANSPORTABLE		
TX. POWER (dBW)	7	7
ANT. GAIN (dB)	13	23
EIRP (dBW)	20	30
PATH LOSS (dB)	192.2	192.2
SATELLITE		
G/T (dB/K)	5	5
UP LINK C/No (dBHz)	61.4	71.4
MARGIN (dB)	2	2
REQ'D C/No (dBHz)	full: 46.8 half: 44.4	full: 46.8 half: 44.4

* Derived from power limit. Frequency limit should be considered.

With regard to the full rate codec, the capacity of the down link is about 1000 channels and it is 2500 channels with VA.

In case of the half rate codec, the capacity is 4000 channels with VA.

7. ECONOMIC FEASIBILITY

The mobile station cost and the transponder leasing cost are evaluated.

The mobile station cost is estimated around 3--4 K US dollars in the mass production phase. Assuming 4 K dollars, it may be recovered by a 500 dollars initial payment and a 80 dollars monthly rate.

Though the S band transponder rate is unknown, let us assume it is equal to five Ku band transponders. Including a C band feeder link transponder, total of 20 M US dollars per year is assumed.

Above costs do not include costs of base stations, communication controls, general and administration expenses. These costs depend on number of base stations and the way of business operations, etc, and probably less than the transponder rate.

Besides of these, the ground link cost should be taken into account.

The transponder rate will be recovered by the following communication fee charged on the traffic.

The traffic is assumed as follows.

(1) The busy hour traffic is 50 percents of the total capacity.
The traffic will grow from initial small quantity to some amount later and the average is assumed 50 percents.

(2) The traffic in a day is ten times of the busy hour traffic.

In the case of the full rate codec, the fee per minute is calculated as

$$\frac{\text{transponder}}{20 \times 10^6} \Big/ \frac{\text{days} \times \text{hours} \times \text{minutes} \times \text{capacity} \times \text{load}}{365 \times 10 \times 60 \times 2500 \times 0.5}$$

= 7.3 US cents / minute

This is the fractional fee corresponding to the transponder rate only.

Similarly, the fractional fee for the half rate codec is calculated as 4.6 US cents/minute.

8. CONCLUSION

Using the codecs for digital mobile telephone systems, mobile satellite communication systems will be realized economically. A satellite having a multiport amplifier can cover wide areas as Asia and Pacific.

I appreciate Messrs. Kunio NAKAJIMA and Shinya TAKAHASHI (Mitsubishi Electric Corp.) helping us about codecs.

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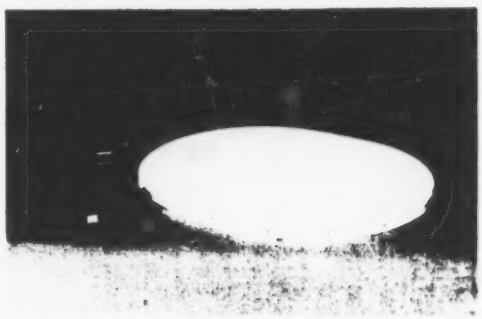

FIG. 7 MOBILE ANTENNA (L BAND)

Full Mesh Digital DAMA

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ABSTRACT

Single channel per carrier (SCPC) and demand assigned, multiple access (DAMA) techniques used in thin route satellite communications provide an attractive method of reducing space and ground segment costs. Instead of dedicated point-to-point links, the system assigns the satellite resource on demand. A much smaller amount of satellite bandwidth can be shared, thus taking advantage of the random and occasional nature of telephone traffic. Since a DAMA system assigns bandwidth on a per call basis, full mesh single hop connectivity is possible—a significant added benefit. This paper examines various architecture alternatives to mesh DAMA SCPC systems and Scientific-Atlanta's approach.

Single channel per carrier (SCPC) systems can be used for satellite based telephony applications where terrestrial solutions are impractical or prohibitively expensive. These thin to medium route systems are economical, reliable and can be deployed quickly. Satellite links are pre-assigned based upon traffic needs at installation time. The pre-assigning of links and the simultaneous multiple access by several sites results in the term PAMA—pre-assigned multiple access.

Each SCPC voice channel is modulated directly on a separate pre-assigned RF carrier, offset from other carriers, on a frequency array that spans the assigned satellite transponder bandwidth. A given telephone call between two sites uses two fixed carriers—one transmitted from each site. Typical frequency spacing is 30 kHz, thereby allowing many carriers in a single transponder. All carriers transmitted from a single site are combined at an intermediate frequency (e.g., 70 or 140 MHz), up-converted to the C- or K_u-band satellite frequency, and transmitted to the satellite.

The received signal is down-converted back to the intermediate frequency (IF) and passed to channel equipment that demodulates the individual carriers. The result is a toll quality link with a small (i.e., roughly 1/4 second node-to-node) delay.

Communication capacity is allocated on a channel-by-channel, site-by-site basis. Thus, in PAMA systems site-to-site connectivity is determined at installation time. New channels can be added one at a time as the system grows by adding an additional channel unit at each site. As traffic patterns shift, capacity can be rerouted by moving channel units and frequency assignments from one site to another.

THE CASE FOR DAMA

Demand assigned multiple access (DAMA) is the next logical development step for SCPC systems. It provides a powerful means for extending the capacity of these systems. Under DAMA control, the SCPC channel connections between stations are dynamically assigned to fit the immediate demands of the traffic load. Because the satellite resource can be shared by all stations, the traffic engineers can size the bandwidth to match overall traffic needs.

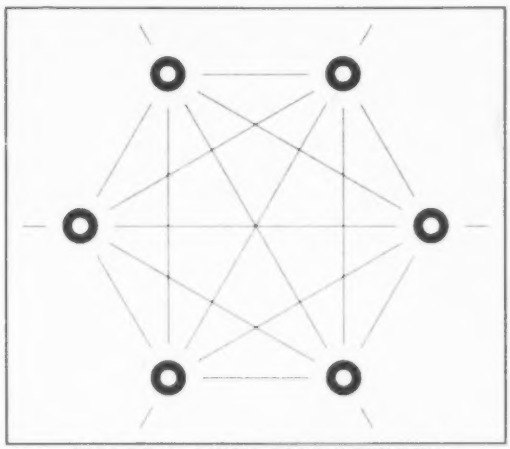

FIGURE 1—MESH CONNECTIVITY

With DAMA, connectivity is dramatically improved. Instead of pre-assigning satellite links, the DAMA system assigns the links as connections are needed, thus exploiting the satellite's ability to connect distant sites to one another.

Connectivity can be achieved in one of two ways. Star connectivity occurs when connections are switched at a master site. Each link in a star configuration requires two hops over the satellite (except for calls that terminate at the master site). Channel equipment at the master site is required for the maximum number of links in the system.

Full mesh connectivity, on the other hand, allows single hop site-to-site connectivity. (Star and mesh connectivity are discussed in more detail below.) Figure 1 is a diagram showing six nodes and all possible connections between them. The number of possible connections is represented by the following formula:

$$L = \frac{(N \times (N-1)) \times C}{2}$$

where:
- L is the number of bi-directional links
- N is the number of nodes
- C is the number of circuits between nodes

If each of the six nodes in Figure 1 are to be connected to the remaining five nodes with one circuit, fifteen bi-directional links are required. While this results in full connectivity, only one circuit is available between a given pair of nodes. Therefore, a second connection cannot be made, even for a short time. Each node would need five channels, even if a given node never had more than one call at a time.

Full mesh connectivity done with dedicated point-to-point connections becomes unworkable for large systems. A 100 node system, for example, requires 4,950 bi-directional links. A system thus connected would require 99 channel cards (N-1) at a small site having full connectivity, and therefore 9,900 channel cards for the entire network—clearly an economically infeasible approach. The same network with full mesh DAMA connectivity would require 100 channel cards and only one bi-directional link for a given phone call. Therefore, a demand-based sharing of the satellite link not only saves space segment resources, but also ground equipment.

APPLICATIONS

A number of technologies have matured in recent years to make a full mesh satellite-based SCPC/DAMA system practical. These technologies include satellite modems, computer hardware, digital signal processing (DSP), voice compression software, solid state power amplifiers, and communication satellites. The near universal acceptance of digital telephony has also helped reduce the barriers to such systems. These technologies have reduced the size, power consumption, development effort, and cost while at the same time increasing system reliability.

The resulting dramatic reduction in procurement and operating cost makes SCPC systems more practical and financially attractive. The primary application of SCPC DAMA systems is rural telephony—to bring telephone service to people who do not have it. Several other applications for satellite-based telephony are also covered by such a system, namely:

1. Thin route telephony, new service
2. Thin route telephony, additional trunking
3. Private or VIP networks
4. Emergency or backup networks
5. Rapid deployment telephone service for new markets or disaster recovery

In addition to the above, there is a growing demand for the retrofit or expansion of existing satellite-based analog SCPC systems.

TRAFFIC CONSIDERATIONS

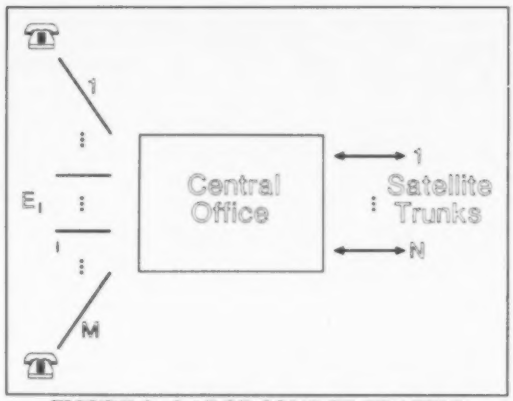

FIGURE 2—LARGE SOURCE TRAFFIC

Traffic accessing the satellite network can be characterized as large source and small source. Figure 2 shows the large source case. The traffic generated from telephones shown at the left of the diagram is concentrated by the central office or PABX and presented to the satellite system as trunks 1 through N. Typically the number of trunks presented to the satellite network would be six or more but fewer than 100. The traffic presented to the satellite system is predicted by the following formula:

$$E_T = \sum_{i=1}^{M} E_i = \eta_T \times N$$

where:
- E_T is the total traffic presented to the system in Erlangs
- M is the number of telephone lines
- E_i is the Erlang loading of each telephone
- η_T is the trunk efficiency
- N is the number of trunks

The trunk efficiency (η_T) is a measure of the loading per trunk and is a function of the number of telephones (M), the number of trunks (N), the Erlang loading per phone (E), and the desired grade of service or probability of blockage (P). The following table shows trunk efficiencies for three different cases. It is assumed for this example that the Erlang loading per phone is 0.1 (E_i = 0.1) and a desired probability of blockage is 0.02 (P = 0.02).

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Trunk Efficiency		
M = 20	M = 50	M = 500
E_T = 2.0	E_T = 5.0	E_T = 50.0
N = 6	N = 10	N = 60
g = 33%	g = 50%	g = 83%
E_N = 0.33	E_N = 0.5	E_N = 0.83

Figure 3 is a diagram of typical small source traffic loading. The figure shows a PABX which switches local calls and hands other calls over to the satellite based system for connection. The second case shows unswitched connections where each phone is connected directly to a channel unit and is always switched over the satellite. Typical values for E_N and N are 0.2 and 4, respectively.

Typically small to medium thin route systems have low trunk efficiencies. These systems, whether switched or unswitched, receive the greatest benefit from DAMA. Although the trunk efficiencies are low, the satellite circuit utilization can, by the use of DAMA, be increased to near 100 per cent provided that the channel pool is sufficiently large.

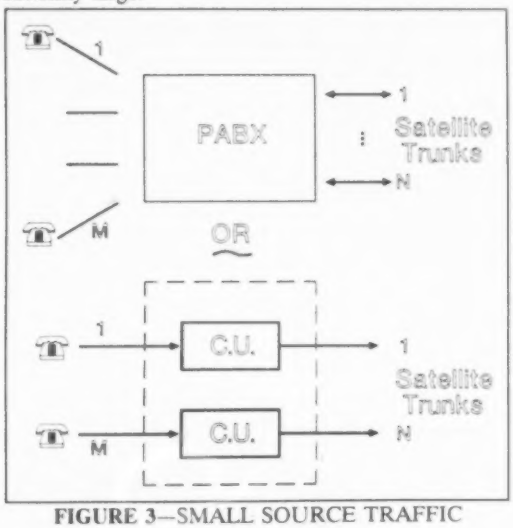

FIGURE 3—SMALL SOURCE TRAFFIC

STAR DAMA

In a star DAMA network (depicted in Figure 4), all traffic is routed through the master site for connection. The master site must coordinate the sharing of the satellite resource. This is accomplished via a common signalling channel that has an out-link from the master and a return-link shared by each remote. Status, requests for service, and frequency assignments are all made using the common signalling channel.

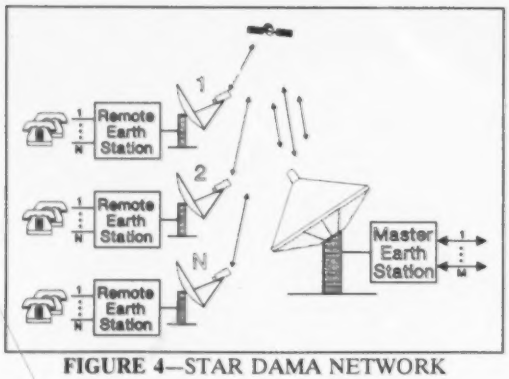

FIGURE 4—STAR DAMA NETWORK

A call from a remote site terminating via a terrestrial interface at the master site would use two frequency assignments. The remote site would transmit on frequency F1 and receive frequency F2. The master would receive F1 and transmit F2. One channel unit at the master and one at the remote would be needed for the duration of the call.

Intra-system calls (i.e., calls that originate and terminate within the satellite system) are switched at the master and connected using a second satellite link. In an intra-system call, two frequency pairs are used. The first remote site transmits on F1 and receives on F2. The second remote site transmits on F3 and receives on F4. The master receives F1, switches it to F3, and transmits F3. The master also receives F4, switches it to F2, and transmits it. The resulting double hop arrangement has twice the satellite delay and uses twice the space segment power and bandwidth. The call requires one channel unit at each of the remote sites and two channel units at the master for the duration of the call.

By assigning frequency pairs only when needed, a substantial reduction in the total bandwidth can be achieved. The resulting bandwidth savings or capacity efficiency is called DAMA gain. Using the Erlang "B" model, DAMA gain for a star mesh system can be computed using the following formula:

$$G_D = \frac{C \times N}{N_S}$$

where:
- C is the number of channels per remote site
- N is the number of remote sites
- N_S is the number of satellite trunks required for a specific grade of service P

Typical values for DAMA gain range between 3.0 and 5.0. The higher the allowable probability of a blocked call, the higher the DAMA gain. Even with an allowance for double-hopped calls, overall efficiency is improved.

A star DAMA configuration has two other signifi-

cant advantages. Because all calls are routed through a central site, a conventional switch can be used to connect calls. Another advantage is that relatively smaller antennas can be used at the remotes since direct remote-to-remote links are never made. Each remote site needs only enough channel cards to support the traffic to and from that site and the master station needs only enough channels to support the total traffic load of the network, but reduced by the DAMA gain.

FULL MESH DAMA

A full mesh DAMA network (depicted in Figure 5) requires single hop site-to-site connectivity. An intra-system call results in a bi-directional channel directly from one remote site to another. One remote transmits a carrier at frequency F1 and receives a carrier on frequency F2. The other remote transmits on F2 and receives on F1. The master site is not needed to relay the call.

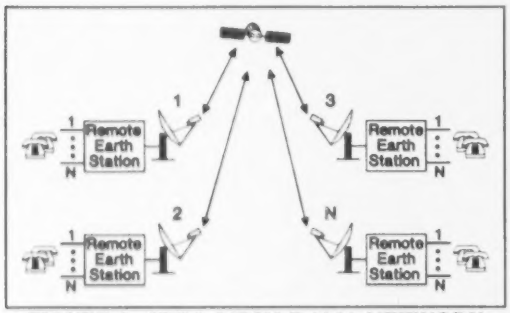

FIGURE 5—FULL MESH DAMA NETWORK

This arrangement uses half the space segment of a star DAMA system for an intra-system call, but it requires more sophistication in the overall architecture. A signalling channel is required to allow sharing of the space segment resource as with the star DAMA system. Since any remote site can be connected to any other remote site, and because remotes typically have varying antenna sizes, uplink power control is required. Each transmitted carrier must be adjusted in power to match that required by the differing uplink and downlink dish sizes.

Another challenge for DAMA systems results from the inherent high connectivity. Instead of routing calls through a central switch which has pre-defined circuit types for various equipment, the mesh network must accommodate the connection of varying types of circuits.

The DAMA gain in this case can be expressed by the following formula:

$$G_D = 0.5 \times \frac{C \times N}{N_S}$$

where **C**, **N**, and N_s are the same as above.

SCIENTIFIC-ATLANTA'S APPROACH

Scientific-Atlanta's Skylinx.DDS Digital DAMA System is designed for thin to medium route telephony applications where full mesh point-to-point connectivity is important. The system makes maximum use of digital signal processing (DSP) and modern electronic packaging techniques. The system was designed for economy of purchase, high reliability, and low maintenance. Telephone, voice band data, and facsimile traffic are carried from one site to another using a single satellite hop. The routing between various sites can be pre-assigned multiple access or demand assigned multiple access. Pre-assigned links and demand assigned links can be mixed within the system.

Figure 6 is a system block diagram of S-A's Skylinx.DDS system. Shown in the diagram is the master station site which is responsible for central control of the system. Three remote sites are also depicted. Two types of channel cards are shown in the diagram. The voice channel unit (VCU) is used to digitize and modulate/demodulate telephone, data, or facsimile traffic. The signal channel unit (SCU) is responsible for system signalling and remote site control. Using separate signalling hardware facilitates maintenance functions (e.g., rapid detection of failed channel hardware) and allows custom calling features (e.g., call waiting).

To conserve satellite power, each carrier is voice activated. During periods of silence, the carrier is dropped, thus saving up to 4 dB of the satellite power. Rapid re-acquisition and data buffering result in an unclipped and apparently seamless telephone connection. Transponder power and bandwidth can be saved while still offering a high level of service.

To guarantee an even higher level of service to critical circuits, the DAMA Controller allows each circuit to be assigned a priority level. Bandwidth can be subdivided so high priority calls get through regardless of the load placed on the system.

Each system has at least one master site and any number of remote sites. Redundancy at the master site protects portions of the system that effect more than one telephone circuit. Redundancy is available at each remote site, as an option. Because of its intended use in rural areas, the system equipment is designed for unattended operation. System monitoring, maintenance testing, data base changes, and traffic data collection can all be performed from a location remote from the equipment.

The system uses advanced voice compression technology. This technology, when coupled to the system's single card modem, provides high quality digital voice using less bandwidth than analog solutions.

A comprehensive software package allows the operator full flexibility to grow and change the system. This package combines call processing, maintenance, and administration software with system-wide monitoring and

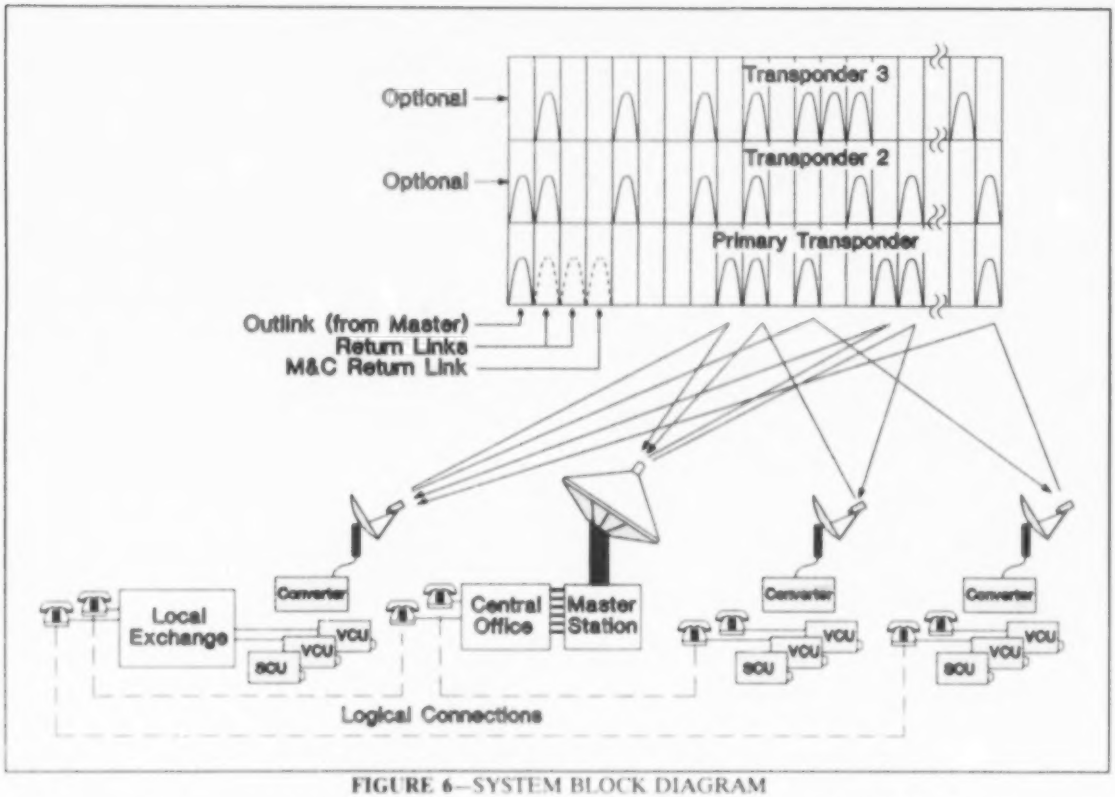

FIGURE 6—SYSTEM BLOCK DIAGRAM

control software. The operator thus keeps in touch with the entire network from a single location.

The system uses a common signalling channel to communicate with the remote sites. This signalling channel consists of a continuous outbound link that is received by each remote and one or more return links as shown in Figure 6. Each remote responds on a return link in burst mode using slotted Aloha. Slotted Aloha is a technique that allows each remote site to send an unsolicited message when it needs to so long as the message begins and ends within a predefined slot time. It represents an excellent compromise between channel throughput and rapid response time.

A separate monitoring and control (M&C) return link uses polling to ensure that service effecting failures are quickly detected.

Modem Technology

The satellite modem employed is a low bit rate SCPC digital signal processing (DSP) based design. This modem operates at two synchronous data rates which are 32 kb/s, 16/2 kb/s, 16 kb/s, 8/4 kb/s and 8 kb/s. The modulation scheme is QPSK at 32 kb/s and QPSK or BPSK at the lower rates. Forward error correction using convolutional coding and Viterbi decoding improves channel performance and acquisition time. Available code rates are 1/2 and 3/4. After initial call setup, the modem acquires carrier quickly (less than 30 ms) to permit voice activation.

This modem plays two roles in the system:

- One is to transport compressed digitized voice or user data over the satellite channel with an acceptable error rate in worst case conditions as part of the VCU.
- The other is to transport the signalling information for each site as part of the SCU.

The modem is a single card design that plugs into the backplane of the chassis. From this backplane, it receives power and communication access to the primary SCU and standby SCU (if equipped). The voice compression CODEC/terrestrial interface is a separate module that is plugged into the modem card. The modem is an all digital design except for the analog 70 MHz upconverter/downconverter and synthesizer. The board incorporates surface acoustical wave (SAW) filters and surface mount technology.

The carrier recovery loop in the SCU modem monitors the frequency of the master station out-link. The continuous out-link from the master can then be used as a system pilot. This eliminates the need for separate dedicated pilot receivers that were used in earlier analog systems.

Common Signalling Channels

Each system has one signalling channel outbound from the master station and one or more return signalling channels. The master station computer operates the entire network using these channels. The signalling channels carry various messages needed to establish, maintain, and terminate network telephone and data connections. System-wide monitoring and control information is carried over a separate return link.

Each signalling channel is operated by an SCU at the master station. These master SCUs are referred to as MSCUs. Each remote site may be equipped with a single SCU or a redundant pair. These remote SCUs are referred to as RSCUs and are identical to MSCUs except for the firmware. The master site communicates with the remotes via a continuous outbound link. The outbound signalling carrier protocol is HDLC. If the master has no messages to send, it sends flags. Each remote SCU continuously monitors this stream of data for messages addressed to its site ID. When it decodes a message for its site, it responds as appropriate on its designated return channel. Remote sites send responses and requests for service via one or more slotted Aloha return links.

The first MSCU is used to generate the continuous out-link. The receive portion of the first MSCU is used to monitor the out-link signal from the satellite so that a failure of the signalling channel is immediately detected. The DAMA controller will immediately begin using the backup MSCU if a failure occurs.

Transponder Utilization

The Skylinx.DDS channel card is frequency agile so that any bandwidth within a given transponder can be used for a given phone call. For large systems a second or even a third transponder can be used. Converter equipment is required to perform the conversion from the system IF to the final transponder frequency. All sites in the system must have equipment to transmit and receive on the primary transponder (transponder 1). The primary transponder is used for the system signalling channels and telephone traffic. To reduce cost, small sites need have no additional converter equipment, so calls to and from small sites will always be assigned to the primary transponder.

Medium sized sites have two converters (and typically, a standby) to transmit and receive from transponders 1 and 2. The master station computers can connect a call using either transponder based on loading, with a default of transponder 2. Large sites may have three converters (and a standby) to transmit and receive from any of the three transponders. The master station computers can connect a large site to a large site on any of the three transponders with a default of transponder 3. By using the highest possible transponder to connect a call, the system preserves the lower number transponders for calls to/from the smaller sites. In order to have full site to site connectivity, every site must be capable of communicating on the first transponder.

The system allocates satellite bandwidth from groups. Group types are signalling, call, and services. The call group is further subdivided into priority. Bandwidth is assigned for each call according the originating circuit priority. The call is assigned bandwidth from the lowest priority group. If there is no low priority space remaining, it is assigned space from the medium priority bandwidth if its priority is medium or higher. If no medium priority space is available, it is assigned high priority space if it is a high priority circuit. If no space is available, the call processing software gives the caller a re-order tone and appropriate blocked-call counters are incremented. Bandwidth may span more than one transponder, up to a maximum of three transponders.

Uplink Power Control

Each VCU has three power levels—low, medium, and high. During call setup, the master station determines the caller and called site characteristics and commands each VCU to go to a power level that is appropriate for the call. The power level used at each site takes into consideration the site's uplink performance and the receiving sites downlink performance. The difference between the high and low power setting is approximately 12 dB.

SUMMARY

The three critical considerations in any satellite based telephone system are voice quality, system availability, and cost. Each of these considerations has an initial and recurring component. Voice quality must be high initially and reasonably immune to noise and long term changes in the system. The system must be reliable when it is commissioned and continue operating when inevitable equipment failures occur. Finally, the per channel and overall system cost must be kept as low as possible, the space segment must be utilized efficiently, and the long term maintenance costs must be minimized.

Digital transmission paired with speech coding offers an alternative to traditional analog transmission techniques. Digital Signal Processing (DSP) and voice compression technology have made it practical and cost effective to use digital transmission techniques. The analog voice signal can be digitized, compressed, and sent over the satellite. Reversing the operation, the destination site reconstructs the original analog waveform with little or no noticeable degradation. When used in lieu of analog methods, digital transmission improves the quality and reliability of the link.

DAMA systems require computers to perform control of the system and allocation of the satellite resource. Modern technology has made computers and the software that runs them more affordable. Therefore the overall system becomes more commercially attractive and easier to justify from an economic standpoint. The combined effect of the converging technologies used in DAMA systems and modern satellites results in a system that can provide high quality service and have a reasonable return on investment.

The Impact of Competition in Satellite Launchers and Spaceports on Pacific Telecommunications

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1. ABSTRACT

Lower cost, lower risk launches of communications satellites may be expected as a result of increasing competition in launch services, the growing number of commercial spaceports, and other factors. These developments could enhance the feasibility of providing improved Pacific telecommunications.

2. INTRODUCTION

Substantial reductions in the cost and risk of launching communications satellites may be expected by the end of this decade. This prospect is due to fierce competition in launch services, the growing number of spaceports available for commercial launches, and improvements in the technology and reliability of launch vehicles. Lower costs and risks should occur simultaneously with the advent of new satellite communications systems, particularly for mobile services, and increased capabilities of satellites and ground equipment.

The confluence of these developments could bring enhanced telecommunications to nations in the Pacific region and could be a boon to providing sorely needed telephone and other communications services to developing countries. These outcomes may not be realized, especially for developing countries, unless other factors become more favorable to greater accessibility to satellite communications services. These are: frequency allocations for the mobile satellite service (MSS), competition in satellite communications and associated telecommunications services, network access, and regulation.

3. LAUNCH VEHICLES AND SERVICES

Competition among launch vehicles, capable of boosting medium to heavy payloads, is fierce (Table 1). The market for commercial launches by this class of vehicles is limited: only 15 to 20 launches per year for the next eight years.(3, 5) Launch firms have engaged in strong price competition which may become more intense as new or upgraded launchers come on line. Launch firms aim to capture business from military and civil government projects, but with shrinking budgets, prospects for a large market in such launches are in doubt. It is likely, therefore, that communications satellites will continue to account for a significant share of the commercial launch business, adding to competitive pressures.

Lightsats (weighing up to 2000 lbs.) may be launched to low Earth orbit (LEO) or to geostationary transfer orbit (GTO) as part of a multiple payload on large launch vehicles or to LEO by small launch vehicles. Price competition among small vehicles and with their larger counterparts will also be vigorous.

In addition to providing the launch vehicle, launch firms also offer a package of services which include payload processing, direction of launch operations, insurance or insurance options. For example, McDonnell Douglas offers add-on options for contracts for its Delta launch vehicles, including limited insurance to satellite owners: the choice of a free launch or a refund if a satellite failure is due to some fault of the rocket. Price competition for such associated services either offered as a package or as options is also expected to accelerate as new launch vehicles and firms enter the market.

4. SPACEPORTS

Competition among spaceports offering commercial launches will be heating up in the next few years. In addition to the spaceports currently operating, more are planned or under study. (Table 2). There is sufficient capacity to accommodate all current commercial launches of large, medium, and small satellites in two existing launch sites--the Ariane launch base near Kourou, French Guiana, (which handles nearly half of all such launches) and Cape Canaveral, Florida, U.S.A. Other spaceports account for a lesser share of launches due to

TABLE 1

Competition Among Large Commercial Launch Vehicles

Launch Vehicle	PAYLOAD CAPACITY LEO	GTO
Ariane 4 (ESA-Arianespace)	21,000 lbs.	9,200 lbs.
Atlas 2 (U.S.A-General Dynamics)	14,500 lbs.	5,900 lbs.
Atlas 2AS (U.S.A.-General Dynamics)	18,500 lbs.	7,700 lbs.
Delta 2 (U.S.A.-McDonnell Douglas)	11,100 lbs.	4,010 lbs.
Long March CZ-3 (PRC-Great Wall Industry Corporation)	7,250 lbs.	3,100 lbs.
Titan 3 (U.S.A.-Martin-Marietta)	32,000 lbs.	10,500 lbs.
Zenit SL-16 (USSR-Russian & Ukraine Republics)	33,000 lbs.	9,900 lbs.
Under Development		
Ariane 5 (1995: ESA-Arianespace)	44,000 lbs.	15,000 lbs.
H-2 (1993: Japan-Rocket Systems Corporation)	22,040 lbs.	8,810 lbs.
Long March CZ-2E (1992: PRC-Great Wall Industry Corporation)	19,400 lbs.	6,500 lbs.
Under Study		
National Launch System Commercial Derivative (2005: U.S.A. -Government R&D)	20,000 lbs.	NOT DETERMINED
Proposed by COMSTAC Innovation & Technology Group		
Low-cost ELV (1999: U.S.A. -Government R&D)	20,000 to 40,000 lbs.	9,000 to 15,000 lbs.

SOURCES: References (2), (8).

TABLE 2

Satellite Launch Sites

AUSTRALIA	Cape York (under study)
BRAZIL	Alcantara (under study)
EUROPEAN SPACE AGENCY/ FRANCE	Guiana Space Center, Kourou, French Guiana
JAPAN	Tanegashima
PEOPLES REPUBLIC OF CHINA	Xichang, Sichaun Province Jiuquan, west of Beijing Taiyuan, Shanxi Province
SOVIET UNION (REPUBLICS OF)	Baikonur (Tyuratam) Plesetsk
UNITED STATES	Cape Canaveral, Florida Hawaii (two sites under study) Point Plata, Alaska (under study)

limited commercial space activity in their countries or other factors. In the case of the Tanegashima launch site in Japan, launches are limited to two periods a year due to objections from fishermen who fear that shuttle will spoil their catches.

Planned or proposed spaceports include launching sites to be operated by the states of the U.S.A. The Florida Spaceport Authority is planning an early 1991 sounding rocket launch from Cape San Blas, Florida. The authority also has a long range plan to refurbish a U.S. Air Force launch pad at Cape Canaveral to accommodate small satellite launches, providing market prospects are favorable. The state of Hawaii is pushing to build a spaceport for small and medium satellite launches on one of two sites on the Big Island of Hawaii. Financing is being sought from private sources. An environmental impact study is underway. Environmentalists and local residents near the prospective sites are opposing the spaceport initiative. Private firms have expressed interest in launching small satellites from a sounding rocket firing range owned and operated by the University of Alaska at Poker Flats, Alaska. Facilities may be upgraded for launching of small satellites should a market feasibility study prove favorable.

The Air Force Phillips Laboratory Systems Directorate at Kirtland Air Force Base has issued a request for proposals for a spaceport at Cape Cod in southeast Massachusetts. Launches of the launch vehicles may be made from this site. This was first begun to get backing from industries in Japan, Europe and the United States. Earlier efforts to locate a spaceport from Massachusetts sources have encountered opposition. The environmental impact study has not begun. The proposed launch operations site

a variety of launch vehicles of the three major U.S. launch firms--General Dynamics, Martin Marietta, and McDonnell Douglas. Proximity to the North Pole of the Kodiak Flats site is an advantage for launching into polar orbits.

[illegible]

The sites will use many new LEO systems for satellite communications including those designed for worldwide mobile telephone service. New small vehicles for launching lightsats into LEO are hoped to attract new launch users. Among such vehicles are the Pegasus, which is launched from an airplane in flight, developed by Orbital Sciences Corp. and the Orbital Express under development by Interorbital Systems. Although the LEO satellites would go on large vehicles as part of multiple payloads with others launch users.

[illegible]

Advances in miniaturization of satellite electronics and other technologies is a major factor in accounting for the growing interest in orbiting small satellites. Technological gains were also helping to make launch vehicles and spaceport operations more efficient. Large launch vehicles under development will have increased capacity to handle up various combinations of payloads. The volume of small satellites weighing a fifth of a ton, the lower end of [illegible] vehicles would have to aggregate launches of several satellites to make the launch cost effective. Small launch vehicles under development will have the capacity to launch satellites weighing a fifth of a ton. The lower end of [illegible] vehicles would have to aggregate launches of several satellites to make the launch cost effective. Small launch vehicles under development will have the capacity to launch satellites weighing a fifth of a ton. The lower end of [illegible] vehicles would have to aggregate launches of several satellites to make the launch cost effective.

the interactions on mission configuration and sparing/maintenance strategies."[9]

The financial simulation model developed by Greenberg and Christensen demonstrates that while high launch cost may be offset by other factors, there also may be a situation in which low reliability and high insurance rate are more than compensated by lower launch cost and higher payload placement accuracy.

Lower launch costs, especially when combined with lower risk, could enhance the feasibility of satellite communications ventures. Launch costs are among the significant up-front expenditures for which financing is more difficult as costs escalate. Motorola is interested in obtaining free launch contracts in exchange for stock in its new Iridium mobile satellite project. Motorola estimates that it will cost at least $570 million for launches of its initial constellation of 77 small LEO satellites according to its filing with the U.S. Federal Communications Commission. Additional funds will be needed to send up replacements. The Soviet Union has expressed investment interest by providing free launch services since they do not have hard currency to offer. The prospect for lower risk launches is one factor which has encouraged new ventures. The decision by Motorola to move ahead with Iridium was influenced positively by this prospect, as well by availability of technologically advanced lightsats.[1]

7.2 COMPETITION

Competition in international satellite communications is emerging. Steps are being taken to ease entry of competitors to Intelsat and Inmarsat. PanAmSat has moved ahead with plans to launch a hybrid C/Ku-band satellite in the mid-1990s for Pacific Ocean region services. Columbia Communications, despite financial problems, is pursuing its plans to lease C-band transponders on a NASA tracking and data satellite in orbit above the Pacific Ocean. Operation of these new systems, combined with existing and planned regional satellite systems serving the Pacific, will expand considerably the options available to users. Growing fiber optic capacity is an additional competitive factor that adds options. Satellite services, however, will remain in demand especially for rural and remote areas, and wherever their use in combination with terrestrial services is more economical or efficient. One benefit of new satellite system entry is that it will provide for higher power satellites, enabling users to receive on smaller antennas with potentially more economical ground equipment and opportunity for further VSAT usage.

7.3 NETWORK ACCESS

Restrictions to network access for satellite and associated services may hurt their accessibility and affordability. As Hudson notes, despite the availability of VSATs and other relatively low cost technologies (VHF, UHF, rural subscriber services, microwave systems, cellular radio, etc.), large parts of the population have no access to reliable communications. While some technologies, such as a microcomputer, can be used "stand alone," a telephone set or a VSAT are useless by themselves. They require a network. In many developing countries, access to networks are hampered by legal restrictions or PTT controls. Although such barriers are receding in many countries, their persistence in some nations will hamper realization of affordable services especially for rural and remote users. Hudson describes a number of strategies for overcoming obstacles ranging from the introduction of autonomous public ownership, a mixed public/private corporation, and privatization. She also notes that satellite communications could play a special role in promoting competition for long distance telephony within a developing country. "Long distance competition in the public network is probably not justified in most developing countries at present because of the dangers of wasting scarce resources on redundant capacity and difficulties in interfacing with local networks. Countries with domestic satellites can introduce long distance competition by allowing the satellites to be used even when terrestrial capacity exists. This approach in India and Indonesia, for example, would enable subscribers to bypass the bottlenecks in major cities."(12)

7.4 REGULATION

To promote widespread, affordable use of satellite communications, regulatory approaches, both international and domestic, must take into consideration the impact of frequency allocation and of standards and prices on the quality and accessibility of satellite services. In cases where an autonomous government structure is set up, oversight is needed to insure that a single provider does not abuse monopoly power in setting rates or discriminating between customers. In a competitive environment, less regulation will be needed, but where demand far exceeds supply, prices may be so high that services for rural and remote users become out of reach. In such cases, explicit subsidies may be warranted. (Subsides should be explicit to prevent a dominant carrier from engaging in predatory pricing.) In the quest for bringing low cost services to rural and remote areas, caution must be exercised by regulators to make sure that prices are not set too low. Government pressure to keep rates down may leave a carrier without adequate resources or facilities.(12)

8. CONCLUSION

The goal of providing enhanced Pacific telecommunications could be furthered by the growing competition among launch services and spaceports. It is important, however, to recognize that launches are only one element in a complex web of factors which influence cost and accessibility, especially for developing countries. Steps must be taken to insure that competition also extends to other aspects of satellite communications and that international and national oversight of telecommunications is geared to facilitating the affordability and accessibility of emerging satellite communications services.

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Petri Nets for Coordinating Studies Across University and National Boundaries in the Pacific Region

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ABSTRACT

We have developed a computer-based methodology for representing intellectually substantive interdependencies among components (e.g., courses, programs, departments, curricula; faculty members) within and among universities. Extended Petri Nets provide the formal basis for this technology. Among the applications in the Pacific region for these education-modelling techniques is the coordination into coherent (and degree-qualifying) programs of study of individual courses taken at a number of institutions, even in different countries and cultures with diverse degree requirements.

The research and development efforts being reported on in this paper, while free-standing and independently employable, are part of a larger research enterprise. That larger research undertaking we have designated Symbol Systems Access--SSA, pronounced 'Say'. The phrase Symbol Systems Access is meant to establish a rubric under which we may properly encompass not only natural languages, taken as systems of symbols (whether in 'written' or oral form), but also all other 'languages,' in the most extended definition of that term--so as to include mathematical, logical, iconographic, musical, and any other (Rough (3)) sets of symbols which in use manifest combinatoric linearities.

The motivation for studying aspects of Symbol Systems Access is an effort aimed ultimately at improving, hopefully radically or even by some criteria optimizing, the availability of such systems for use by our species (9). One underlying and Enlightenment assumption is that through access to symbolic 'capital,' as stored in texts and the like, on average people do better in relating to their environments, not least of all for being able to work through the implications of possible actions symbolically (as in 'gedanken experiments') rather than by in effect 'acting out' (as the psychiatrists say), often with unfortunate consequences and sometimes with disastrous results. Using symbol systems, the modelling and simulation capabilities of people are important, as of course they also are with computer-based information systems.

Research on some aspects of this problem of optimizing Symbol Systems Access is being conducted within The University of North Carolina system. Professor Kenneth D. Shearer, Jr., of The North Carolina Central University campus within the UNC system, has published a number of papers in the general domain of linguistic geography (22-25). Those papers seek to lay out in a well-organized format the relevant informational resources available to us, as well as specific empirical data and inferencing from it, with reference to differences in access to certain forms of intellectual capital or knowledge or instantiated symbolism publicly available (e.g., in books and journals, in data bases and knowledge bases) as a function of which symbol systems or languages (e.g., French, or Formal Logic) one knows, or doesn't know (14). That is to say, given the fact that you know Chinese, for example, but not Montague Grammar, what is available to you and what is not in the way of the species's total accumulated store (intellectual capital) of Symbol System instantiations?

Initially, Kenneth Shearer was led to try to answer some of these questions in consequence of an experience he had a few years ago as a consultant on modern information systems and libraries for the government of Kuwait, when he observed that if a person knew only Arabic accessibility to children's literature was extremely restricted. Since then on a global basis he has generalized and systematized that kind of question, as well as the process of searching for answers to it. In doing so he has repeatedly emphasized the transcendent importance for SSA--transcendent relative to the boundaries of nation states--of the language communities to which people belong, the congeries of individuals knowing a specific symbol system or language, by comparison with the nation states of which they are citizens or residents. Unfortunately, such data as we have relative to these questions tends to be available only on the sometimes less relevant nation state basis, if at all.

The importance of that approach taken by Kenneth Shearer currently is being underscored by the migration of information sector jobs, or, alternatively put, symbol manipulative jobs (by contrast with, say, manufacturing jobs), from one nation state to another, provided there are users of the same symbol systems in both countries. The

presumption is that labor cost differences as between any such pair of nation states is sufficiently great to override the expenses of such a partial international transfer of business operations. Recently a highly visible instance of such a migration of symbol manipulative or information sector jobs has been taking place between the United States and Ireland. In Ireland in smaller cities 'trainers' are teaching local people with high school educations how to perform symbol-manipulative work roles in finance, in effect taking over from U.S. employees tasks which here often would imply an MBA degree. If those Irish citizens had known only Gaelic, as would have been true of some of their ancestors, especially in the west of Ireland, their lack of access to a relevant symbol system (in this instance, English) would have precluded the possibility of such employment; it would not have been what we have denominated a post-possibility of their language learning. In a recent article in The New York Times it was noted not only that these Irish employees command less in the way of salary and total compensation than the Americans they are displacing, but also that, come hell or high water, their motivation to hold onto those jobs was far greater, owing to a lack of present and future alternative work force opportunities, in a land where the unemployment rate and the birth rate are both so comparatively high. From similar causes (the reserve work force problem), as well perhaps as owing to differences in the current distribution across the two cultures of certain personality traits, presumably primarily in consequence of divergences in child-rearing and other cultural patterns, the level of precision of execution of the work force tasks in question was much higher in Ireland than here.

For the Pacific region there is a special relevance of this Ireland-U.S. development, inasmuch as heretofore the economic functions that have migrated across the Pacific and elsewhere generally were not out of the information sector of the economy, were not symbol manipulative. The manufacture of clothing, automobiles, electronic appliances are cases in point, all of them not untypical of the first phase Industrial Revolution, even when in fact they are inventions of the past hundred years. By contrast with the migration of such 'blue collar' manufacturing roles as these, now it is evident that it is possible to move symbol manipulative jobs as well, as with tasks which have been performed in the U.S. by literate Anglophones now migrating across the Pacific to, say, the Philippines, or Singapore, or Hong Kong. But the significance of understanding the phenomena in question is by no means confined simply to the economic implications of workplace relocation; rather, we see, additionally, how the adaptability to new roles for the workforce within any language community in no small measure will follow from its history of access to instantiations of specific symbol systems (e.g., reading in English about business matters, or, in any language, reading in the literatures of technology and science). The impressive recent comparative regression as to numeracy and literacy of American students, vis-a-vis the students in other advanced industrialized nation states and even in some that are not very industrialized, could be taken as a disquieting or even alarming case in point, in that over the longer term and mid term the level of living in nation states where such a regressive development takes place can only be adversely affected by such relatively poor access to relevant symbol systems.
Reliability of data with reference to levels of numeracy and literacy has proved to be a serious research hurdle for Kenneth Shearer and others; generally, government education offices tend to inflate upward in their reportings on levels of literacy, and as to reliable data as to the accessibility (through public libraries, schools, private holdings, etc.) of books, computer-based information, and the like in which instantiations of the symbol systems are to be found, the wickets are far stickier.

Professor Raymond Carpenter at The University of North Carolina system's Chapel Hill campus, among a number of his research interests, only some of which are within this general domain, has published on the implications of the translation process for symbol system instantiations access (2). Working with printed documentation, some of it of course from the United Nations, as well with computer tapes, Professor Carpenter also has found the path to reliable conclusions strewn with obstacles. Nonetheless, and no doubt aided by his experience as a social science methodologist and as a member of the international committee on the standardization of library statistics, he has been able to arrive at the most accurate picture to date of the international 'balance of payments' between languages translated out of and into, between interlingual lenders and borrowers of symbol system instantiations in the form of printed texts. Raymond Carpenter's research has extended from gross total figures to breakdowns by category of literature (such as scientific or humanistic). While much of Raymond Carpenter's attention has in the nature of the case focussed on European languages, as also with Kenneth Shearer, he has as well directed his gaze to other parts of the globe, including so-called Third World communities. Perhaps even more than for Professor Shearer, there have been difficulties for Professor Carpenter to contend with, in that such relevant data as we have tends to be organized by nation state rather than by language. While for certain purposes that type of breakout is not only understandable but needed, in other respects that type of data reporting perpetuates the illusion of the significance of the political entity over against the significance of the

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people(s), the population(s), for which it is but one form of more or less useful aggregation. In some instances the dimension of language community membership is the more significant (26), as we are currently seeing to be implicated in popular attempts at disaggregation in Eastern Europe (e.g., 'Yugoslavia') and at reaggregation in the Western Pacific (e.g., students and bureaucrats in 'North Korea' and 'South Korea'; also, the Chinese in Formosa vis-a-vis those on the mainland). To date the pace of transcendence, and/or dissolution, of nation state boundaries in the Pacific region has been notably slower than in some parts of Eastern and Central Europe, and probably even slower than Catalunian and Basque and Breton and Fleming and Scottish efforts in Western Europe. In Europe it is now widely apparent that for many economic functions the nation state idea has produced entities that are too small to be at all optimal, while it has produced entities that (in part owing to language community identifications) are too large for certain ethnic, psychological, and communicational functions. But growing Japanese economic hegemonization in the Pacific (and globally ?) may come to speed the pace of revelation there too of the permeability of nation state boundaries, and a heightened, complementary sense of the significance of language use as an alternative type of cleavage plane among people. (There is an ironic footnote to be found in the fact that sometimes Serbian and Croatian are taught as though they were one language, Serbo-Croatian, rather after the manner of sometimes teaching Danish and upper register Norwegian as though they were but parts of one language, 'Scandinavian.')

Japanese leadership in machine translation--if not as to the prerequisite linguistic research (pace Professor Nagao), at least as to number of MT systems in place and, by some criteria, functional--may be interpreted as an index of the isolation of speakers of only Japanese from users of other symbol systems, many of whom are present or potential customers and trading partners for Japan. Other considerations apart, these economic motivations are powerful vectors for driving Japanese interest in such developments as automatic speech-to-speech translation systems as may come to be realized in telephonic communications. Such systems would be notable as, inter alia, creators of potential, and transient, and dynamic virtual symbol systems access. Machine translation, whether of the traditional textual or of the prospective oral variety, is at least in principle a partial technological fix of a very powerful sort for some problems produced by limitations in symbol systems access which techniques of conventional schooling in languages have not provided an adequate solution to anywhere. Nor is language teaching ever likely to, given the sheer number of languages to learn and the speed and degree of economic and communicational integration on a global scale; even the language learning record of such high achievers as, say, the Dutch does not, practically speaking, promise much with reference to Swahili, Chinese, Russian, Arabic, Hindi, etc., especially if one considers the existing workload of Dutch 'gymnasium' students. It may be apropos to suggest that for the Pacific region, and especially in larger time frames, one of the more salient dimensionalities affecting the rates of economic exchange and integration will be the infrastructural capacities for coping technologically with symbol systems access problems across linguistic boundaries. Interlingual mapping across symbol system semantic space differentials is a powerful emergent research concern (14), as discussed in a companion paper ("Interlingual Semantic Mapping") for this conference.

For our own research, the stars by which we seek to navigate include the optimization of symbol systems--as distinct from, and in addition to, the accessibility of instantiations of specific symbol systems. That is to say, we also are interested in how any given symbol system may be optimized relative to our emerging understanding of how the human brain and nervous system (and not excluding motor memory) conduct their computing (19); and, on the other side, we also are interested in the optimization of specific symbol systems relative to specific configurations of computer hardware/software/communications properties and to the already encoded knowledge which is to be input to the relevant computer-based information systems. Of course, some of these optimizations may be mutually incompatible, and a higher level trade-off optimization may have to be resorted to; also, re-examinations of the knowledge representation structures (10) and utilizations employed for public encoding of science and technology, etc., may lead to more adequate formulations of that knowledge, sometimes merely through freeing knowledge from no longer relevant dialectical and hermeneutic assumptions that were a part of the context of its initial emergence. An example of optimization of an intermediate symbol system--intermediate as between the symbol set of the symbol system, per se, and a specific use of it--would be with reference to a programming language, where in producing a revised version of it one would seek to make it generally more apt to the performance of some programming task(s), such as character level access for earlier versions of FORTRAN. Similarly with reference to natural languages: currently a research activity for us is trying to make it possible easily to convert English into an REL (Rapidly Extensible Language, or Lexicon), on the analogy of the aspirations for the REL movement of twenty to twenty-five years back apropos programming languages. More specifically, in another research effort, we are studying how automatically to add at the

appropriate nodes (8) new terms to a general purpose, conceptually organized thesaurus, such as Roget's; a new grant (for research on "Foundational Knowledge Representation for Knowledge-Based Systems") from The National Science Foundation (Knowledge Models and Cognitive Systems Program) should facilitate that work during the next several years. An example of what we are tackling is the achievement in specific sublexicons of finer granularity, of more discriminating lexical subpartitioning in sectors of a whole language's total semantic space, of higher resolution semantic discrimination through the automatic introduction and placement of neologisms as required.

Over the still longer term, we also are guiding our research by an aspiration to make it possible automatically to re-encode the content of books so that they may be employed as knowledge bases, as for use in Expert Systems (15). The current practice of building anew expert systems and their underlying knowledge bases one by one, as by analogy was done in weaving when accomplished by handlooms before the Industrial Revolution, seems needlessly inefficient when one considers the implications of extensions of Montague Grammars into Extended Phrase Structure Grammars, as well as other developments (e.g., Unification Categorial Grammars; lattices as knowledge representation structures [Zellig Harris; Rudolf Willie and his associates on the mathematics faculty at the Technische Hochschule Darmstadt]; John McCarthy and others re 1st Order Predicate Calculus), which taken together are leading toward the possibility of formally converting running text into an interlingual form such as may be used in logic programming. The recent achievement of spectacular gains as to compaction in data storage, such that, with the single atom switch technology, in principle the entire contents of the books in The Library of Congress can be placed on one silicon disk twelve inches in diameter, is a strong motivation for research on how automatically to convert book-length language strings into expert systems, insofar as those strings embody expertness.

The great bulk of the content of courses offered in universities in the Pacific region as well as elsewhere is instantial of symbol systems, whether used in oral form (e.g., lectures) or in printed form (e.g., reading assignments in books, on CRT displays). Put most comprehensively, what we are concerned to do with this utilization of extended Petri Nets is so to enable the coordination of experiences of instantiated symbol systems in a variety of languages, both natural and formal(ized), as to make it possible for people enrolled in universities or in more deinstitutionalized settings ("distance education") to achieve coherence in their intellectual and academic experiences. Again, the precedental significance of what

is happening in Europe--especially Western and Central Europe--is very considerable for the Pacific area. What has happened in the United States and with the EC will happen more often in "the new Europe" as a whole. Increasingly we may expect to see students transfer with far greater frequency than heretofore from one institution to another during the course of their studies--in part in consequence of the increased integration of the global economy, so that, job opportunities beckoning, students combining work with education may move to other schools. More and more that may be expected to happen even across national boundaries. In the Pacific region further facilitated there by the fact that current broadcast technologies employed for distance education are especially well-suited to the patterns of population distribution in Indonesia and Alaska and other Pacific territories, so that a useful infrastructure for distributed education may be more likely to be already in place there than in a high population concentration setting such as The Netherlands. And yet another important facet of the need for knowledge representation structures adequate to show relationality among components of intellectual experience and education is the need for literature conversability. In any Pacific region country, the United States, the problems attendant upon the lack of uniform national standards for licensure (as in medicine, law, nursing, etc.) may range [illegible] from [illegible] to [illegible] to [illegible] to

stressing intellectual and symbolistic interdependencies; some further implications of this work are brought out in our companion paper for this conference, wherein a similar methodology is directed at a related set of topics. As we have sought to make manifest in the course of this paper, the nature of the university scene in the Pacific region makes the results of our research seem especially applicable there.

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result of low investment as a share of GDP in the sector.

(3) Large number of waiting applicants

Demand for telephone services had been growing especially in big cities. At the end of 1985, there existed 380,000 registered waiting applicants and 68,000 new applicants. The number was equal to about 70% of the total telephone main lines (602,000). The annual increase rate of waiting applicants from 1981-85 was about 30%. Potential demand seemed to be larger than this figure since many people were discouraged from applying for the service by the long waiting period.

(3) Unsatisfied grade of services

The system had not been facilitated in a good balanced manner. For example, the automatic telephone rate was as high as 90%, but the automatic exchange rate was 26%. A great portion of the long distance calls was handled by the operator assisted system. The switching, subscriber lines, and transmission capacities were not well balanced in many areas. As a result, call completion rate became low.

(4) Long delays in project completion

The completion rate of the third five year development plan was only one half of what had been planned to accomplish, and that of the fourth plan was estimated to be the same rate as the third plan. The greater part of the projects remained unfinished as carry over projects at every end of the plan periods.

(5) Shortage of investment fund

The capacity expansion plans in the fourth five year plan were to increase the capacity at the rate of 20% to accommodate the increasing number of waiting applicants. 60% of the investment fund, to carry out the fourth plan program, was raised from outside fund. The recent stagnation of the economy caused by declined oil prices makes the availability of investment funds difficult.

(6) Worsening financial performance

The revenue per telephone main line during the 1980-84 period had been increasing at the annual rate of 3% in real terms, while operating expenses in the same period increased by about 9% due to mainly the increase in staff salaries and wages, which grew at about 10% in real terms. Therefore, the increasing tendency of operating expenses should have been reduced to a lower level than that of revenues for future healthy management.

1.3 COMPARATIVE ANALYSES FROM EXPERIENCE OF COUNTRIES

One approach to determination of the appropriate balance between telecommunications supply and demand is to examine actual experience of countries in various stages of development.

The following indexes were utilized to compare the current status of various operating aspects as well as the socio economic environmental positions of seven countries during 1981-85 periods. The data was used from ITU published "Yearbook of Common Carrier Telecommunications Statistics, 1991 edition." The seven countries are Indonesia, India, Thailand, Malaysia, Singapore, Korea, and Japan.

A. Telephone main line per 100 population
B. Investments as a share of GDP (1/1000)
C. GDP per capita (1980 price in US$)
D. The ratio of telephone demand (the number of waiting applicants and new applicants) to the number of telephone main lines
E. The ratio of telephone supply rate (the incremental rate of telephone main lines from the previous year) to telephone demand
F. Total staff in telecommunication services per 1,000 telephone main lines
G. The ratio of operating expenses to total revenue from all telecommunication services

(1) GDP per capita: C and investment share: B

Scatter diagrams of these indexes, taken in pairs, are plotted as an aid in understanding the nature of the relationships between the indexes. Figure 1 is the scatter diagram of GDP per capita versus investment share. It is important to note that as GDP per capita increases, investment share increases sharply at first (like Malaysia), but it declines slowly (Singapore), and then, becomes constant (Japan). This shows that telecommunication investment needs more in the medium level of development stage.

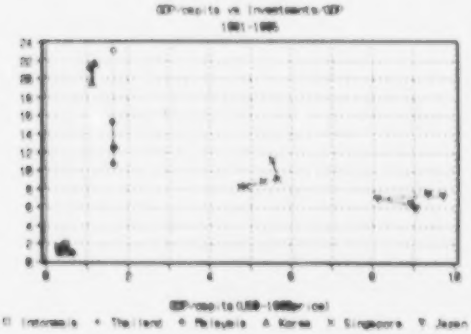


FIGURE 1 GDP PER CAPITA VS. INVESTMENT SHARE

(2) The ratio of telephone supply rate to demand (%): E and the ratio of demand to telephone main line (%): D

Scatter diagrams of these indexes, taken in pairs, are plotted in Figure 2, which shows that in the initial stage, demand is lower as compared with telephone main line like Indonesia and India. But, as the supply rate increases slowly, demand increases sharply, and thus the ratio of supply rate to demand decreases, while the ratio of demand to telephone main line increases rapidly like Thailand. If investment share is to be increased to solve this situation enough to cover the increment pressure of demand, finally, the

2.11

continuous investment will increase the supply rate higher than the demand increase enable to meet almost 100% of demand every year like Japan.

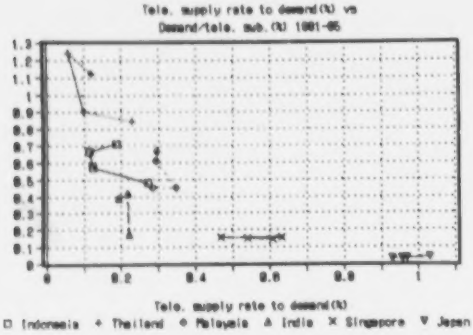

Tele. supply rate to demand(%) vs
Demand/tele. sub.(%) 1981-85
Tele. supply rate to demand(%)
□ Indonesia + Thailand ◇ Malaysia △ India × Singapore ▽ Japan

FIGURE 2 THE RATIO OF TELEPHONE SUPPLY RATE TO DEMAND VS. THE RATIO OF DEMAND TO TELEPHONE MAIN LINE

(3) Total staff per 1,000 telephone main lines: F and the ratio of operating expenses to total revenue: G

Scatter diagrams of these indexes, taken in pairs, are plotted in Figure 3, which shows that the ratio of operating expenses to revenue becomes lower as the number of staff per 1,000 main lines decreases. This means that productivity increase will bring about better financial results.

It is noticeable that if investment increases to meet the demand, the operating entity should have such measures as reducing operating expenses as much as possible since depreciation and interest payment amounts increase so rapidly due to the large investment. This is a sign of lower ratios shown in the case of Thailand and Malaysia.

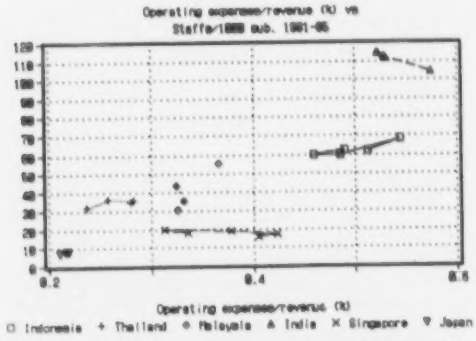

Operating expenses/revenue (%) vs
Staffs/1000 sub. 1981-85
Operating expenses/revenue (%)
□ Indonesia + Thailand ◇ Malaysia △ India × Singapore ▽ Japan

FIGURE 3 TOTAL STAFF PER 1,000 TELEPHONE MAIN LINES VS. THE RATIO OF OPERATING EXPENSES TO TOTAL REVENUE

(4) Telephone density: A and staff per 1,000 main lines: F

Scatter diagrams of these indexes, taken in pairs, are plotted in Figure 4, which shows that productivity increases according to the increase of telephone density.

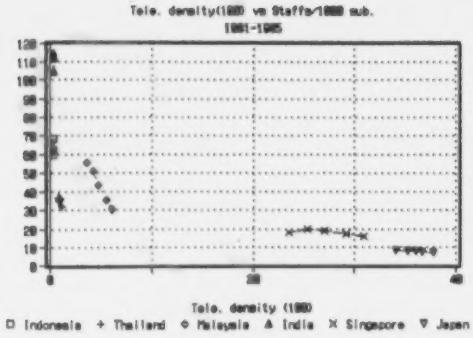


FIGURE 4 TELEPHONE DENSITY VS. STAFF PER 1,000 MAIN LINES

3.4 TWO COUNTRIES COMPARISON OF THE INDEXES

Radar charts of these 7 indexes from A-G for two countries comparison are drawn in Figure 5 for Indonesia, and Thailand, in Figure 6 for Indonesia, and Malaysia, in Figure 7 for Indonesia, and Singapore, in Figure 8 for Indonesia, and Japan. According to those figures, if we regard these countries as future development stages of Indonesia with respect of different level of GDP per capita, we can see four stages with numerical comparisons following from Thailand, Malaysia, Singapore, and Japan.

(1) The first stage

The ratio of operating expense to revenue can be reduced by increasing productivity to take such measures as reducing staff per 1,000 telephone main lines and start to increase investments that enable the speedup of telephone supply.

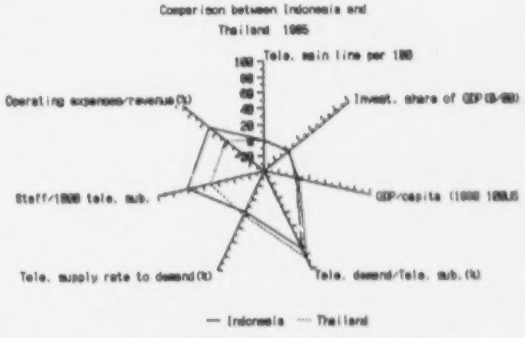


FIGURE 5 COMPARISON WITH THAILAND

(2) The second stage

Large investments will turn to be larger amount of depreciation and interest payments, thus, operating expenses should be reduced enough to cover those amounts. Due to large investment, the ratio of telephone demand to telephone main line starts to decrease since the telephone supply rate is increased over that of demand. We may say this is the first critical mass (CM).

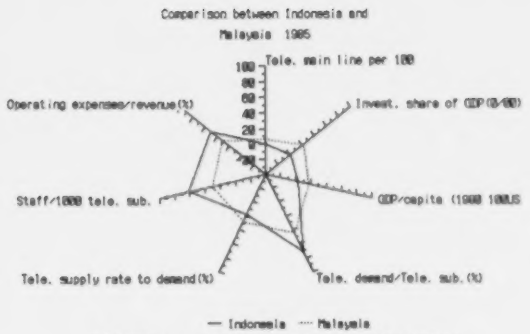


FIGURE 6 COMPARISON WITH MALAYSIA

(3) The third stage

Though investment amount increases continuously, the investment as a share of GDP will keep constant since GDP per capita increases higher than that. Telephone supply rate increases so rapidly, and eliminates the past high pressure of demand than that of the second stage since we passed CM period.

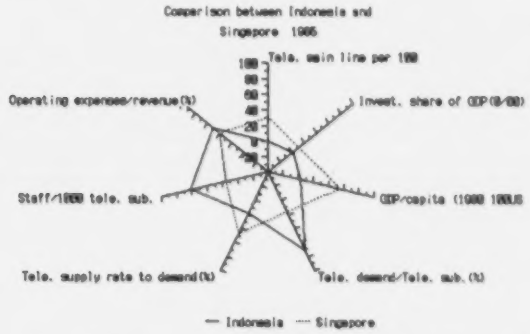


FIGURE 7 COMPARISON WITH SINGAPORE

(4) The fourth stage

The telephone supply increases continuously, and we finally reach the meeting point of demand and supply. Thus, we can supply 100% of demand every year. The age of Plain Old Telephone Service will end and a new era starts.

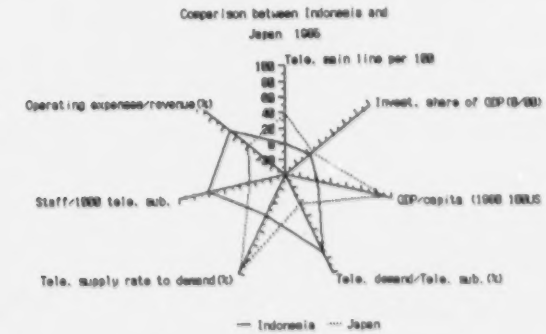


FIGURE 8 COMPARISON WITH JAPAN

4. DEVELOPMENT TARGETS AND STRATEGIES

4.1 DEVELOPMENT TARGETS

(1) Telephone density

The figure of telephone density is a key index of the country's level of telecommunications development. Thus, it is very important to increase this figure by accelerating the increase of the supply rate.

(2) Waiting periods for subscription

This figure also shows the level of the supply rate. To eliminate the waiting list, we should supply the numbers exceeding the increase rate of demand with careful consideration of priority given to area and user categories.

(3) Service standards

Service standards are the provision of automatic dialing or the increase of call completion rates.

4.2 DEVELOPMENT STRATEGIES

(1) Investment strategies

A. Service categories

Present main services consist of telephone and telex. However, it is possible to introduce other non-voice services in urban areas.

B. User categories

The first priority of the service provision goes to the business and official use customers. In urban areas, some of residential demands should be also satisfied.

C. Network coverage

At present, public telecommunications network is extended only to big cities. Thus, it is difficult for many people living on the outskirts of big cities to access telecommunications services. To realize the national development plans, it is essential to provide to all persons within a walking distance.

D. Supply rate

This is the incremental rate of telephone supply number as compared with the previous year. If this rate increases year by year, we may say the supply speed becomes up.

E. Regional priority

The government usually makes a plan given to priority by each region. To fulfill the plan, we should follow this regional priority. There is a contradiction between profitability and regionally balanced development.

(2) Operation strategies

A. Financial strategies

The structure of money inflow and outflow is

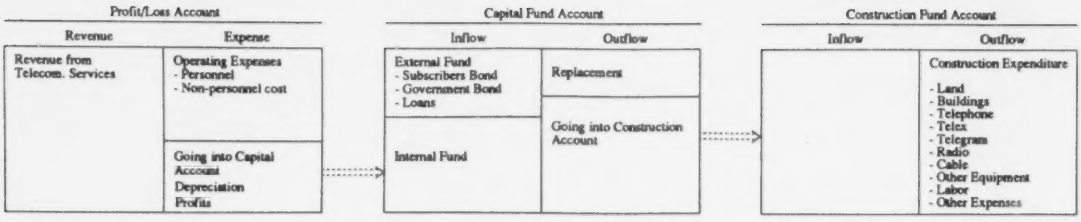


FIGURE 9 FINANCIAL STRUCTURE

explained in Figure 9. Important financial statements are three shown in Figure 9, which are interrelated to each other. It is noticeable that the amount of investment is determined by the amount of internal fund, which is composed of net profits, depreciation, and equity being invested by the government. Thus, if we can increase the internal fund by reducing operating expenses, we can increase the amount of external fund which is determined by that of the internal fund shown by repayment capability. The simple method to increase the level of investment as a share of GDP is to increase internal fund by adopting the internal management strategies.

B. Tariff strategies

PERUMUTEL's overall tariffs were higher than mean value in the Asian countries. Average telephone revenue per telephone main line in 1985 was recorded to be US$847. Present tariff systems were designed to cover the operating expenses. However, the new system can be proposed to create sufficient internal fund, and then, expand the capacity to eliminate huge waiting applicants, imp'ementing such new measures as discriminating business and residential user fares, or reexamining the current zone classification for call charges.

C. Manpower development strategies

One of the criteria which are generally used in judging efficiency of manpower of telecommunications service provider is the number of staff involved per 1,000 line units. When the figure of staff per 1,000 telephone main lines is compared with that of the other countries, the figure of Indonesia seemed high. A simple comparison does not necessarily represent a real picture. Indonesia's tough geography and needs for creating employment opportunities must be considered. However, the most productive level of manpower should be realized in quantity and quality.

5. DEVELOPMENT OF STRATEGY SIMULATION MODEL

5.1 INTRODUCTION

The PERUMUTEL corporate model had been developed as a planning tool to assist decision makings on long-term investment projects. The model consists of a system of statistical equations which were estimated by using the operating data of PERUMUTEL from 1981-84.

The aspects to be modeled are:
(1) the demand for the services and the revenue estimation,
(2) the service provision and estimation of operating expenses,
(3) the investment planning and estimation of fund size required and its sources, and
(4) the profits.

These aspects are incorporated into sales, manpower, production, investment, fund, and profit management in actual planning.

5.2 THE STRUCTURE OF THE SIMULATION MODEL

Figure 10 shows the flowchart of the model. First, the amount of newly created capacity to the PERUMUTEL system in period t (DCAPt) is given to the model as the first exogenous variable. Then, the amount of total capacity of the PERUMUTEL in the period t (CAPt) is determined with the amount of total available capacity in period t-1 (CAPt-1) and DCAPt.

CAPt is, then, distributed among 12 regional offices (WITELs). This decision can be made by the model operator exogenously. The amount of total available capacity of the i-th WITEL in period t is determined.

The number of telephone service (Sit), telex service (SXit), and data communication service (SDit) subscribers are determined by the subscriber demand functions of the telex and data communication services. The traffic volume of telephone service (XTXijt), telegraph service (TLGit), and Telex (XTXit) are calculated by the traffic models of these services.

The revenue (Rit and Rt) are, then, calculated by the tariff rates/fares (PIit, PMit, PCit), the subscribers and the traffic volume. At the same time, the personnel (PCit) and non-personnel operation (NPCit) expenses (O&M Costs) are derived from the personnel and non-personnel expenses functions, and the telegraph traffic. It is also possible to derive the number of staff in the i-th WITEL from PCit by the average wage.

Depreciation expenses, interest payment, and tax are calculated from the investment amounts, and the earnings before tax are calculated from the above revenue and operating expenses.

As an independent module of the above flow, the number of people who desire to start subscribing the telephone service (Dit) is estimated by the telephone service demand subscriber demand function. The number of the waiting applicants at the end of period t-1 (Wt-1) plus the number of new applicants in period t as new demand in pe-

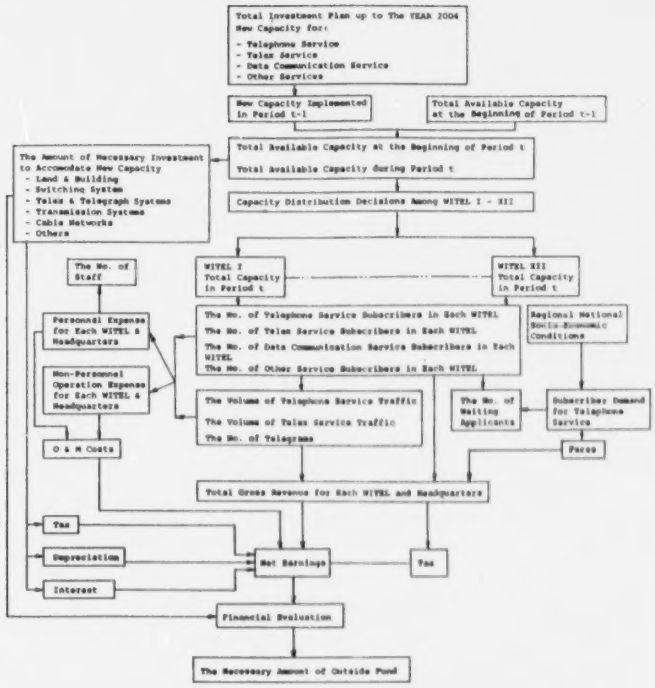

Total Investment Plan up to The YEAR 2004
New Capacity for:
- Telephone Service
- Telex Service
- Data Communication Service
- Other Services
New Capacity Implemented in Period t-1
Total Available Capacity at the Beginning of Period t-1
The Amount of Necessary Investment to Accomodate New Capacity
- Land & Building
- Switching System
- Telex & Telegraph Systems
- Transmission Systems
- Cable Networks
- Others
Total Available Capacity at the Beginning of Period t
Total Available Capacity during Period t
Capacity Distribution Decisions Among WITEL I - XII
The No. of Staff
WITEL I Total Capacity in Period t
WITEL XII Total Capacity in Period t
Personnel Expense for Each WITEL & Headquarters
The No. of Telephone Service Subscribers in Each WITEL
The No. of Telex Service Subscribers in Each WITEL
The No. of Data Communication Service Subscribers in Each WITEL
The No. of Other Service Subscribers in Each WITEL
Regional National Socio-Economic Conditions
Non-Personnel Operation Expense for Each WITEL & Headquarters
The Volume of Telephone Service Traffic
The Volume of Telex Service Traffic
The No. of Telegrams
The No. of Waiting Applicants
Subscriber Demand for Telephone Service
Fares
O & M Costs
Total Gross Revenue for Each WITEL and Headquarters
Tax
Depreciation
Interest
Net Earnings
Tax
Financial Evaluation
The Necessary Amount of Outside Fund

FIGURE 10 FLOWCHART OF THE STRATEGIES SIMULATION MODEL

riod t is determined by the size of population (Nit), the level of income (Yit), the number of telephone services subscribers at the end of period t-1 (St-1) and the real subscription fare (PIit). At the end of periods t, the number of waiting applicants (Wit) will be derived from the difference between Dit (=Wit-1+NAit) and Sit.

As another independent module, necessary amounts of various investment funds, which are induced by the addition of new capacity, are estimated. New investments for the accommodation of new capacity are calculated as exogenous variables.

Finally, the amount of the net earnings, subtracted by depreciation, interest, and tax payments, is figured out. These figures are compared with the amount of investment for a financial evaluation, and then, how much amount of the external/outside fund (OFt) is needed to carry out the investment projects. The schedules of various OFt's are presented for the entire project periods for different combinations of the policy variables.

5.3 THE SPECIFICATION OF THE MODEL

(1) Telephone service subscriber demand

The new subscriber demand function for 12 WITEL areas is as follows:

$$Dit/(Nit-Sit-1)=0.1365+0.7773*(S/N)it-1 -0.0108*PIit+0.00008*Yit$$

where
PIit: Real installation fee of WITEL i in period t
Yit: Real income (GDP) of WITEL i area in t
Sit-1: The number of subscribers in WITEL i at the end of period t-1
Nit: Population of WITEL i area in t

(2) Telex service subscriber demand

The estimated model for Indonesia is as follows:

$$Log(SX/S)=-1.7934+0.72074*log(SX/S)t-1-0.03506* log(SD/S)t-1+0.35164*ID$$

where
SX: No. of telex service subscribers (1,000)
S: No. of telephone service subscribers (1,000)
SD: No. of data terminals (1,000)
ID=1 for Indonesia
=0 for other countries

(3) Data communication service subscriber demand

The estimated model for Indonesia is as follows:

$$Log(SD)=-8.7778+(0.7707+0.11487*TD)*log(S) +3.1724*ID$$

where
TD: Telephone density per 100 population
S: No. of telephone service subscribers (1,000)
SD: No. of data terminals (1,000)
ID=1 for Indonesia
=0 for other countries

(4) Telephone service traffic

The estimated traffic model for inter-province is as follows:

Log(XTPij)=-4.31559+0.61196*log(Sj)+0.51539*
log(Si)-(1.7117-0.1092*D8RS)*log(Pij)

where
XTPij: The volume of traffic of the telephone service from the i-th province to the j-th province in period t
Pij: Pulse per minute from i-th to j-th province
D8RS=1 for if the traffic is between Sumatera Utara, Sumatera Barat, Sumatera Selatan, DKI Jakarta, Jawa Barat, Jawa Tengah, DI Yogyakarta, Jawa Timur
=0 for others

(5) Telegraph service traffic

The estimated model for Indonesia is as follows:

TLGit=-137.636+(12.236+5.2345*TDit)*Nit
+(0.33045-1.4697*TDit)*Yit

where
TLG: No. of domestic telegrams (10^5)
N: Population (10^6)
TD: Telephone density per 100 population
Y: Real GDP of 1980 price in US dollars (10^9)
ID=1 for Indonesia
=0 for other countries

(6) Telex service traffic

The estimated model for inter-province is as follows:

Log(XTXit)=6.2730+[0.36966+0.06061*(Y/N)it]*
log(SXit)

where
XTXit: No. of pulses in the i-th province in period t (10^5)
Nit: Population (10^6)
Yit: Real GDP of 1975 price in Rp. (10^9)
SXit: No. of telex service subscribers

(7) Operating expenses functions

Personnel expenses (PC) and non-personnel expenses (NPC) for WITELs and headquarters are estimated as follows:

Log(PCit)=-7.8904+0.58137*log(Sit)+0.46621*
log(TLGit)+0.4933*log(SXit)
-2.9141*DHQ+WITEL Dummies

Log(NPCit)=-12.1103+0.62486*log(Sit)+0.87236*
log(TLGit)+0.28314*log(PCit)
-0.6705*DHQ+WITEL Dummies

where
DHQ=1 for Headquarters

(8) Gross earnings (GE)

Gross earnings (real terms) in WITEL i are estimated as follows:

GEit = Rit - PCit - NPCit

where
Rit: Real revenue amount in the i-th WITEL in period t

Gross earnings (real terms) for PERUMUTEL are calculated as follows:

GEt = GEit

(9) Net earnings

Net earnings (real terms) for PERUMUTEL are calculated as follows:

NEt = GEt - DCTt - ICTt - TCTt

where
DCTt: Real depreciation amount in period t
ICTt: Real interest payment amount in period t
TCTt: Real tax payment in period t

(10) External/outside fund

Real external/outside fund (OF) to be raised for PERUMUTEL is calculated as follows:

OF = FRt*(NEt+DCTt)

where
FRt: The ratio of raising internal and external fund

6. SIMULATION RESULTS OF STRATEGIC DEVELOPMENT

For the simulation, important variables for examining through experiments to understand a few possible future prospects are as follows:

A. GDP per capita
B. Tariff rates
C. Annual telecommunications service supply volume
D. Regional/area priority
E. Productivity increase
F. Diversification of funds source

The impacts of the above variables changes on PERUMUTEL can be evaluated by the financial profitability indexes shown in Figure 11, and then, we can figure out their feasible combinations of actual numerals for the formulation of development plans.

6.1 SUPPLY VOLUME

By examining a supply volume of the telephone, the relationship between telephone density and national income (GDP/GNP) per capita of countries in the whole world can plot a statistical line which shows an average supply volume for a given level of GDP per capita is usually utilized for the purpose of setting targets level of development in many countries. In the past, Indonesia experienced far below this average line due to low investments. Thus, the primary targets should be to catch up with the other Asian countries. Supply volume should be regarded as the most important figure. We may set two targets of supply volume according to the estimates of future GDP growth rates, that are, Plan 1 (low

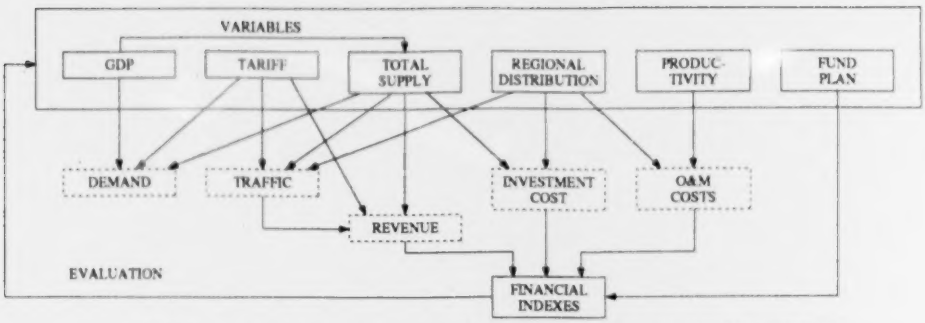


FIGURE 11 IMPACTS OF VARIABLES CHANGES ON THE FINANCIAL INDEXES

supply volume as a result of low GDP), and Plan 2 (high supply volume as a result of high GDP).

6.2 REGIONAL/AREA PRIORITY

Strategies can be classified into past policies to follow in the future (strategy A2), and, the new policies such stressing more on financial profitability, that is, investing more on urban areas and business use (strategy A1), or stressing on the balanced development, that is, investing more on rural areas and residential use (strategy A3).

6.3 PRODUCTIVITY INCREASE

Strategies such as manpower development to increase productivity are very important for the increase of investment. We may take three types of strategies and their applied results are expected to be M1 (best), M2 (second best), and M3 (most likely)

6.4 TARIFF CHANGES

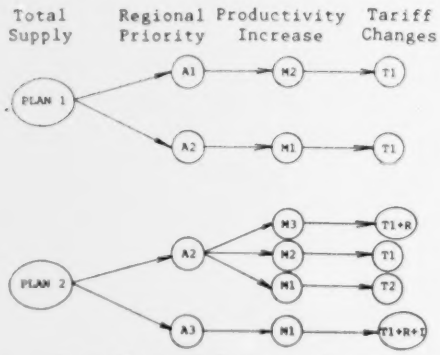
Since tariff rates were regulated by the government, only opportunity to increase the tariff rate is to meet the deficits happened by uncontrollable incidents. However, we may set our strategies of T1 (raise call fee), T2 (raise call fee slightly), T3 (unchanged call fee), R (raise annual rental fee), and I (installation fees) for experiments of our simulation model.

6.5 EVALUATION OF STRATEGIES

If the provider expects lower GDP and chooses Plan 1, the feasible combinations of either strategy A1 or A2 as its regional/area priority policy, the strategy M1 for the productivity increase, and the strategy T1 for the tariff changes, will satisfy the financial criterion.

If the provider expects higher GDP and chooses Plan 2, three feasible combinations of strategies will satisfy the financial criterion for the strategy A2. Those are i) the combination of M3 and T1+R, M2 and T1, M1 and T2. For the strategy A3, only one combination, M1 and T1+R+I, can satisfy the criterion.

The selection process for the combination of strategies is shown in Figure 12.



A1: Capacity expansion in major cities
A2: Capacity expansion in line with the past capacity expansion
A3: Equal capacity expansion in all
M1: Best (e.g., to realize 20 staff/1,000LU)
M2: Second best (e.g., realize 30 staff/1,000LU)
M3: Most likely (e.g., realize 40 staff/1,000LU)
T1+R+I: Increase of call, rental, installation fees
T1+R: Increase of call and annual rental fees
T1: Increase of call fee annual
T2: Slight increase of call fee

FIGURES 12 FEASIBLE COMBINATION OF STRATEGIES

7. CONCLUSION

Since telecommunications can provide more efficient but less expensive means of communication, a good network is essential to Indonesia, where transport costs are high due to the geography, enables people to disperse industry to the regional cities by attracting private investments, and enables people to hasten national integration among widely diversed population.

Corporate simulation model is a planning tool to assist decision makings on long-term investment projects. Decision makers can examine what will happen to the telecommunication sector if they continue to employ the current policies. A wide range of possible future prospects can be examined so that they can make advanced preparations to formulate optimum development plans by extracting feasible combinations of strategies for a given development target.

Interlingual Semantic Mapping

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ABSTRACT

Even when people do not share a common language, computer-based information technology can be employed to lower language barriers in interpersonal communication--in the Pacific, and elsewhere. Short of machine translation (MT), one approach to such communication-barrier reduction is by way of the science of whole-language semantic characterization.

Perhaps someday any one of us will be able to speak into a microphone attached to a computer and receive a response, without regard to the language of the speaker or of the respondent. That day probably will not come very soon, despite the heavy funding being expended on speech understanding and generation in the United States and in Japan, to name two major supporters of such efforts. In an up-beat article appearing in the The New York Times on last August 14, Glen Rifkin (1991) pointed to systems which understand commands such as "Give me a list of all airports in Tunisia" and respond with a list of airport locations, or, in another example, a user says "I want to fly from Boston to San Francisco on July 4. What flights are available?" Again, information is displayed on a computer screen in response to the request. Such systems as these, the former being developed by Bolt, Beranek, and Newman, Inc., and the latter by Stanford Research International, are thought to be prototypes of the future of computing--a future which in this case is concerned with the "free interaction of the computer by voice" (Rudnicky, in Rifkin, 1991). Although such programs may indeed represent steps in the direction of such free interaction between voice and computer, clearly, because of their restriction to very limited domains of discourse, they are tiny steps. Also these programs have no design component dealing with translation (MT) between different natural languages, such as English and Japanese. Rather, these programs focus solely upon communication between a human voice and a computer. This type of communication, though, is also seen as a step toward spoken interaction between natural language speakers who do not share the same natural language.

But exchanges among language users content to use written input and output on computer screens and/or computer printers are closer to hand. Indeed, there is already a great deal of material which is translated from one language to another solely by machine, but the quality of those translations is generally not high enough to facilitate easy exchanges, even though basic understanding may occur.

Whatever form interpersonal communication takes--either spoken or written--an interlingual mapping [Linguistic Equivalence] from the meaning of the words and phrases in one language to those in another language necessarily must take place. It is with an eye toward facilitating that interlingual mapping that one focus on our research is directed. Our concern is to try to characterize the semantic spaces and subspaces [partitionings] of whole languages such as English. Given such characterizations for natural languages, it then would be possible to see what the fit is between and among languages. To speak anecdotally, we all know that here in Hawaii it is not possible either in Polynesian languages or in English to discuss snow with the same degree of specificity and, in a sense, sophistication, as it is in languages used by circumpolar peoples. Thus, there is a lack of "fit" among the languages along this particular semantic dimension. As we all know from individual efforts to learn other languages, such lacks of fit are frequent. Even when there seems to be word-for-word correspondence, it often turns out that the words are used differently, and word senses especially differ. For example, even though there is a preposition "fur" in German which corresponds to "for" in English, and so on through a list of such prepositions, the actual usage of those prepositions differs greatly, i.e., where "for" might seem appropriate in English, "mit" for "with" might be used in German. At present, our own research to systematize (R. Wille, 1990) the analysis of semantic space for whole languages concentrates less upon function words such as prepositions than it does upon so-called content words. Function words long have been regarded as the province of scholars and scientists primarily interested in syntax--in the words binding together the components of sentences--and content words have been the concern of those of us

primarily focused upon semantics. But it is evident that syntax and semantic categories often make for false distinctions, and it certainly will be necessary to incorporate the meanings of function words such as prepositions into whole-language semantic characterizations (S. Sedelow, 1987).

Our own concern with content words stemmed from our desire to develop the ability to extract automatically organizing ideas or concepts from a document or text. Initially we concentrated upon English and we also decided to proceed associationally. That is, our hypothesis was that we don't understand a sentence by mentally referring to a dictionary definition for each word in the sentence and then somehow multiplying all those definitions together so as to get at the semantic interpretation of the sentence. Rather, we hypothesized that we understand strings of words through association. As infants and small children, we are taught to associate given words with given objects, and then we accept words as surrogates for objects and string them together into sentences such as "The lamp is on the table." In time, we may learn that the lamp on the table is different from the lamp a miner wears when moving through a mine shaft, although both lamps have characteristics in common. Thus, we create associative spaces which overlap in some ways and not in others; the lamp on the table and the miner's lamp both provide illumination, but they differ as to expected shape, location, and so on. Our interest in associational semantics as well as our interest in using the computer to extract organizing or major concepts from documents and texts prompted us to look for some kind of lexicon organized associationally and ranging over an entire language. I should stress here that we were seeking a computer-based system which would deal with documents in any subject which might be discussed in a language such as English. Hence, we were not interested in building the sort of system focussed upon, for example, when planes fly from Boston to San Francisco--which of course comprises a very limited domain. Thus, no toy or miniature lexicon would have been suitable for our purposes and we certainly didn't want to create afresh a lexicon for, e.g., the English language. Rather, we wanted a lexicon that had some established validity; that is, a lexicon which was widely used both through time and across geographical areas defined by the speaking of English. We have come to call such a lexicon "culturally-validated," meaning that it has been used by many people for many years to facilitate the understanding of language strings (sentences, etc.) in a given language. The obvious culturally-validated resource based upon association is a conceptual thesaurus, and not a dictionary. In a thesaurus, words are "defined" through their grouping with other semantically-related words. In a dictionary, of course, words are defined through a series of short sentences and examples of the use of a word through a phrase or clause. After a comparison of two thesauri and a synonym dictionary, we settled on Roget's International Thesaurus, 3rd edition (1962), and obtained permission from the publisher to put that version of the thesaurus into computer-accessible form. Having done so, we could of course use the thesaurus to work up lists of words closely related to words appearing in a text, and this is an approach used by some today who buy one of the thesauri available in computer-accessible form. Such thesauri often are set up alphabetically like dictionaries and their primary purpose is to assist people who are searching for an alternate to a word they have used too often in a paper or proposed speech. Roget's International Thesaurus is not organized like a dictionary. Rather, its explicit structure appears to be a hierarchy as in Figure 1:

```
Class Six: Intellect
   III. Communication of Ideas
     K. Written Language
       603. Book. Periodical
         603.7
           dictionary, wordbook, lexicon,
           vocabulary;
               dictionary
```

Figure 1

At the top level of the Thesaurus there are eight classes, of which Class Six: Intellect is one. At the second level, each of the classes is divided into sub-sections, designated by Roman numerals. These sections in turn are subdivided into categories designated by capital letters in the Roman alphabet, and within those divisions are levels designated by numbers (in the example, 603. Book. Periodical); there are 1040 of these categories in the Thesaurus. The 1040 categories are divided into paragraphs headed by an arabic number; these paragraphs are untitled, with the exception that some have a part-of-speech designation (e.g. Nouns) preceding the number. Within the paragraphs are groups of words linked by commas and bounded by semi-colons and, finally, at the bottom are the individual words. As you can guess from looking at the hierarchy, for the purpose of simply finding words closely related to a word in a text, we would look at the level bounded by a semicolon--in the example: "dictionary, wordbook, lexicon, vocabulary."

Almost immediately we wanted to do more than simply use the Thesaurus as a guide to words within a particular semantic subspace. We wanted to know how the Thesaurus, itself, was structured internally. Obviously, it included a hierarchy but what were the biases of the Thesaurus? Were some lexical areas more heavily represented than others? And,

if so, how could we go about discerning that? It also seemed to us that it ought to be possible to use the Thesaurus as an aid to automatic disambiguation--that is, we wanted the computer to determine, with the help of a thesaurus, what particular sense of a given word was being conveyed by a specific use of that word. In many languages, many words have more than one sense or meaning, and the users of any one language customarily have very little trouble disambiguating among those senses so as to zero in on the sense being used in a particular context. Intuitively, it seemed to us that a particular semantic subspace in the Thesaurus could be identified through the context in which a given word appeared, so that "arms" meaning parts of the body could be automatically distinguished from "arms" meaning military weapons. Clearly, in order to detect and explicate such relationships, a principled, rigorous way of moving around in the Thesaurus was necessary. One simply couldn't move around in a somewhat random fashion, hoping that associations might fall into place. The mathematical model developed by Robert Bryan (1973, 1974), once our doctoral student, provided the principled guide to the computer system seeking information in the Thesaurus. This model has been described not only in Bryan's original papers but in subsequent presentations directed to a variety of audiences. For the sake of clarity here, we will again provide a brief exposition of the model, with apologies to those of you have encountered it elsewhere.

The Bryan model is based upon Entries, Words, and Categories, all of which are formally defined. Intuitively, they are understandable through this T-Graph representation (Figure 2):

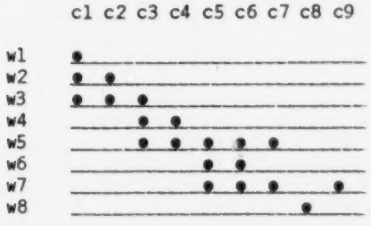


Figure 2

In this T-Graph above, the entries would be e11, e21, ...e88, the words would be the words would be w1 through w8, and the categories c1 through c9. Bryan also defines a Molecule, which consists of all the words and categories denoted by the entries. So that, if our set of entries were: (e11, e21, e22), the range of the molecule (the m-chain) for this set would be the set (w1, c1, w2, c2). The range of words would be the set (w1, w2) and the range of the categories the set (c1, c2).

To move around among the entries, no matter where they might occur (utilizing the multilocality property [possible for any given word], and thus obviating the need to refer exclusively to the explicit hierarchy), Bryan defined Chains, ranging from Type 1, the most general, to Type 10, the most restricted. For the purposes of our research, Type 9 and Type 10 chains have proved most promising, because they call for strongly-linked connectors--a situation in which at least two categories (in our research to date, the semi-colon groups were designated as the categories in question) contain more than one word in common, or at least two words contain more than one category in common, as in Figure 3:

657.2.1 route, itinerary, course, path, track, run, line, road;
273.5.2 progress, course, run
275.6.2 course, run, passage
391.5.2 melt, run, thaw, colliquate

Figure 3

As you see, the top three groupings of words are strongly linked, whereas the bottom group, in which the only link is "run" (and it clearly has a different sense, or meaning, from the closely related top three groups), is not strongly linked to any of the other groups shown in Figure 3.

As we had hoped, the Bryan model enabled the computer to automatically disambiguate among word senses. In a recent presentation to the Dictionary Society of North America, our student, Victor Jacuzzi (1991), described an approach which capitalized on Type 10 connectivities and produced groupings such as: "abstract, nonobjective" and, as another sense, "abstract, remove"; or, in another example: "absorption, assimilation, ingestion" as opposed to "absorption, engrossment, preoccupation." Earlier, Archie Patrick (1985), working with the subset of verbs in the Thesaurus, also produced computer programs which discriminated among homographs (words which are spelled in the same way, but have different senses). For example, his approach discriminated between "magnetize" in the sense of "electromagnetize" and "magnetize" in the sense of "hypnotize" and "mesmermize"; another example, "flower" meaning "flourish" as opposed to "flower" meaning "garland" and "wreathe."

Work such as that of Patrick and Jacuzzi, as well as recent work by Brady and Old, confirms our belief derived from earlier research using the Thesaurus that it mirrors (especially at lower hierarchy levels) very accurately the associational patterns used by English speakers for, among other processes,

interpersonal communication. In a paper presented at the Spring, 1991, sessions of the Midwest Artificial Intelligence Conference, Brady (1991) showed how to use Categorial Grammars in interaction with the Thesaurus to discriminate among word senses. This project was of particular interest because it compared very favorably with an effort by Kenneth Church, now at Bell Laboratories, and Patrick Hanks (1990) to use textual context for generating concordances which might be of use to dictionary constructors. Specifically, as to senses of the word "save," Church and Hanks grouped together under the sense "Save Person from Bad," the following:

1) to save Indian tribes from genocide at the hands of

2) to save him from undue trouble and loss of money

3) to save more powerful Democrats from harm

4) to save my five children from being burned to death

5) save us from sin

Under "Save Person from Bad Location," were:

6) save the toddler from an abandoned well

7) save two drowning boys from a turbulent creek

Brady's computational approach, using the Thesaurus, resulted in three divisions, rather than two, of the sentences above. His divisions were as follows: I. "Save Person from Killing/Death/Fluids," under which were grouped, from above, Sentence 1 (Blood Relationship, Thesaurus), and Sentence 4, 6, and 7 (Youngling, Thesaurus). Brady's second division was, from the Thesaurus, "Save Person from Inexpedience"; Sentence 2 above fell under this category. Brady's third Thesaurus-based division was "Save Person from Vice," which took care of Sentence 5 above. (Sentence 3 above fitted into another of Brady's divisions: "Save Plan/Politics/Association from Inexpedience/Failure," not discussed here.) As is evident, Brady's programs using context and the Thesaurus provided for more fine-grained distinction among word senses than did the Church and Hanks technique, based on co-occurrence of words in context, including 'markers' such as "from."

In a paper presented to the Dictionary Society of North America, another of our students, John Old (1991), showed how word senses align among the Thesaurus, the Oxford English Dictionary, and a study by the noted linguist, George Lakoff, and his student, Claudia Brugmann (1988), on the senses of the word "over." Very briefly, after analysis of quantities of data, Old noted that "over" meaning "across to" superimposed the senses of the definitions of "over" which are in the OED. "Across to" closely matched Brugman and Lakoff's choice of a central sense for "over," "above" + "across" and to the central sense of the "across"-containing semi-colon group in the Thesaurus. However, in the Thesaurus the central sense based on the number of links to other senses of "over" is "additionally." This comparison may suggest, among other things, that Lakoff and Brugmann depended upon dictionaries rather than Roget-style thesauri for at least part of their analysis. In any event, the strong overlap among all three categories of word senses further encourages us as to the validity of the Thesaurus.

All of the work cited thus far has concentrated upon the semantic spaces of a single language, English. We have conducted one study, involving English and Chinese, which has been reported upon elsewhere (J. Sedelow, 1987), but because it is germane to the meetings here, we will briefly cite some of the aspects of that study. For the Chinese component we relied upon Bernhard Karlgren's (1974) list of 5000 Chinese stems, or simplicia (represented in English by 6181 English words). Our approach was then to take the English words approximating each stem word and distribute them against the Thesaurus, to see how many "hits" we would get and what the patterns would be. The resulting pattern we took as support for the observation that Chinese, as well as other Oriental languages, places less emphasis upon semantic polarities, or opposites, than do Western languages. For example, "substantiality" had a hit rate of 3%, while its opposite, "unsubstantiality" registered only 11.95%. Here are figures for some other opposites: "relation" 17.05%, "irrelation" 8%; "similarity" 18.75%, "dissimilarity" 9.23%; "agreement" 22.76%, "disagreement" 5.95%; "superiority" (16.61%), "inferiority" 11.21%. Clearly, partitioning in Chinese differs from that in English, at least on the basis of the representation of those languages in the Karlgren simplicia and the Thesaurus.

For purposes of interlingual communication, we think it would be attractive to be able to pick words in one language and examine the path (as in a T-Graph) linking the words together and then perform the same exercise for the analogous words in the other language(s) involved. Differences in the paths ought to reveal something about differences in word senses, both at the obvious and at the subtle levels.

When we talk about semantic space and semantic subspaces, as well as about interlingual mapping, the notion of semantic distance--of closeness and lack of closeness among terms--seems implicit in such

[illegible]

[illegible]
[illegible]
[illegible]

[illegible]

A structured diagram that contains information for operations systems analysis is introduced. The diagram is called Operations Systems Analysis Information Diagram (OSAID) and includes five essential elements of telecommunications operations systems. An OSAID example of inward line trouble report and testing is illustrated; however, the methodology can be applied to other types of operations as well, such as service provisioning. Furthermore, in addition to being a method the diagram is also a modeling tool. An example of a queuing simulation model based on an OSAID diagram is given.

[illegible]

Operations systems (OSs) have been used to assist in the operations of telecommunications operations for more than two decades. Some important motives of having OS include the reduction of manual and paper works, reduction of processing time, and increasing efficiency. A result of using telecommunications OSs is automation, i.e., mechanization of operations (for customer service and network management). Meanwhile, centralization of work locations is another result. OSs have provided remote operations capabilities so that technicians can perform a wide range of work from a central location, such as trouble reporting and testing from a single customer service center.

Traditionally, operations systems are developed mainly for one organization's automation need. For example, most billing systems are developed for automatic bill printing and mailing; these usually do not have a feature such as real-time access to billing information for customers. Therefore, as the need for centralization and integration grows, it is expected that more complicated operations systems will be required to better streamline OS data dependencies and synchronizations to use shared data.

Because of the increasing use of new technologies to manage telecommunications operations and the presence of highly automated, intelligent, and stand-alone equipment or network elements, modern operations have to deal with information management to a much greater extent. Thus, in this paper, a simple diagram is introduced to help construct and analyze operations flows.

OSAID

Considering an OS as a processing system, in which either physical work or information is provided to perform certain OS function(s), is the basis of this diagram approach. A sub-process or step is to complete a task that will add value to the whole process. It can be either information processing or physical work. Basic elements for analyzing operations are, therefore, related to the components that affect the process. It is necessary to know what, who, and how to perform the work and its way of transformation (input and output). OSAID is a diagram (see Figure 1) in which five elements are centers onto designated positions of the a large box, which has an upper and lower rectangle. The upper part is used to name the operation. The lower part is divided into four small triangles; input and output are on the left and right, and organizations and data source are on the top and bottom. Figure 2 shows an OSAID of a inward line trouble reporting and testing process. For the illustration purpose, the example shows partial work flows and data sources. The five elements of OSAID are explained in the following:

1. Name of the operation - An operational process name, preferred to be short and descriptive, is given on the top of the diagram. For example, "Receiving Customer Trouble Report" is an appropriate operation name.

2. Task(s) to be accomplished - The key activities of an operation are listed. The activities will "add value" to the whole process. For example, " Talk to Customer A

Figure 1. Elements of OSAID

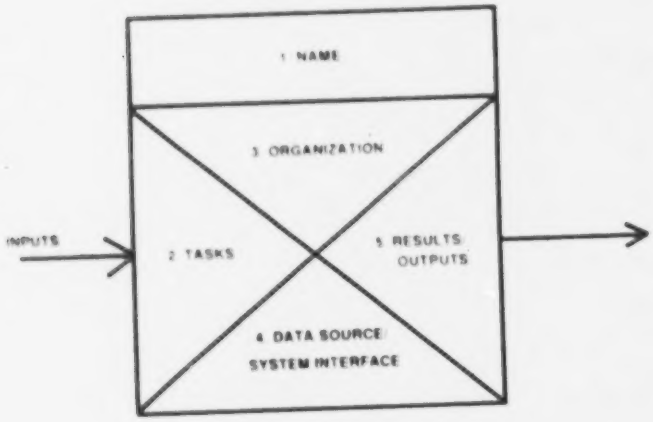
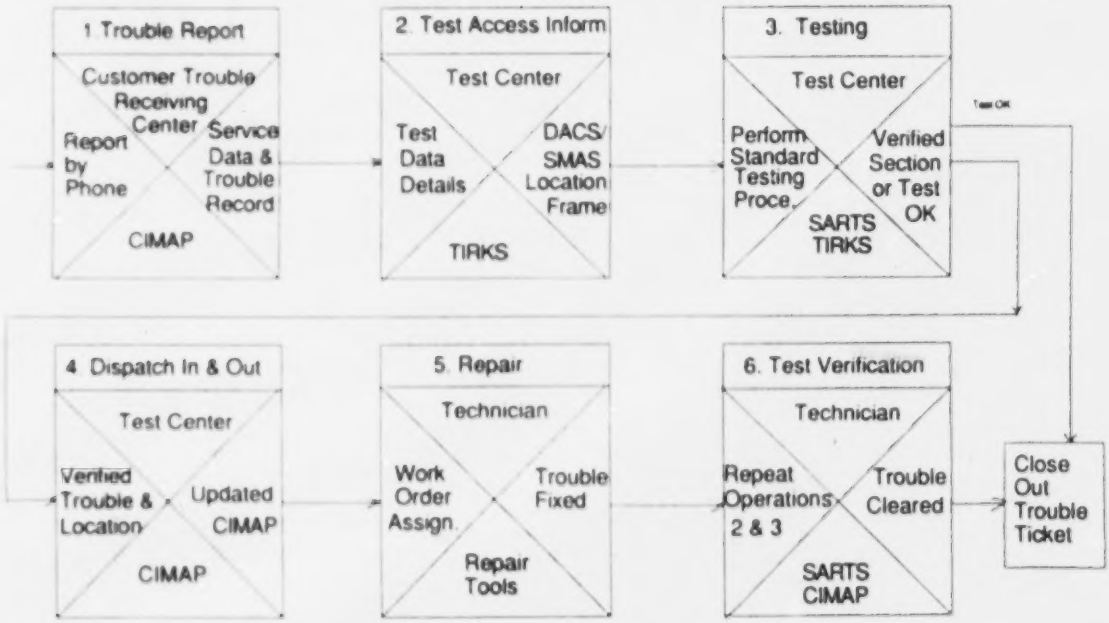


Figure 2. OSAID of a Special Service Testing Process (High-Level)



Generate Trouble Ticket" are value added activities in the "Receiving Trouble Report" operation.

3. Organization(s) responsible for the operation - The responsible organization is the work performer or information provider of an operation. Though, in many cases, the human-touch is unnecessary for performing a job, it is critical to know who is the responsible person (organization). For example, the customer service center may be an organization responsible for a leased line service's trouble report and testing.

4. Data source to support the work - Operations systems, files, databases, or records that support the completion of tasks are listed here. For example, the trunk records and remote testing systems are the main information sources needed for identifying service troubles.

5. Result/Output of the operation - The result of an operation, either physical work, document, or information, is the output of the process, and it usually becomes the input for the next operation. For example, the output of "Receiving Trouble Report" is an initial trouble ticket, which becomes an input for the next operation, "Trouble Isolation and Repair".

Although various kinds of diagraming methods have been used in the past, OSAID presents a structured way that is quiet easy to understand and to use. OSAID is an "operations oriented" diagraming methodology and can be useful by system planners, designers, developers, and operations staff.

In order to compare OSAID with other tools, two operations flow diagrams are illustrated in Figures 3 and 4. Figure 3 includes detail organization and system links shown together with the work flow process. It contains significant amount of information; however, this type of diagram is usually difficult to understand and explain. Figure 4 presents operational flows (rows) according to the corresponding organizations (columns). The data source information is not available in this type of diagram. In advanced operations environments, a diagram similar to Figure 4 is insufficient to show data source or system relations.

The following list is to characterize OSAID and includes its advantages.

- Standard Operations Diagram - OSAID can be considered as a common practice tool. Since it is relatively easy to construct and explain, the users can expect effective communications by using the methodology.
- Flexible Detail Level - The OSAID user determines the level of detail according to the information needed. However, it is important that the user knows and maintains the same level of detail for the entire process.
- Input-Output Concept - The diagram forces analysts to think of information or functions in the form of input and output. Via the diagram, one can assess the purpose or function of an operation based on the input/output relations.
- Value Added View - Due to the input-output concept built into the diagram, the value added by one operation can be identified based on the flow chart.
- Data Source/System Interface Information - The diagram provides clear data source/system interface information (name of the system or database and interfacing method). When automation and centralization are implemented widely, a centralized data source should appear throughout OSAID diagrams.
- Graphical Presentation - Identical to the form in Figure 1, computer graphics can be generated to represent any operations processes. Conceivably, a graphical presentation provides the benefits such as easy to use and flexible to change to those large scale and complicated systems.
- Computer Simulation - OSAID can be easily modified and becomes a waiting line (queuing) model. A simulation will require additional information , such as event occurrence and processing time patterns. An OSAID model can be extended directly for simulation. An example of using a General Purpose Simulation System (GPSS) package for simulation modeling is given in the next section.
- System Development Tool - OSAID can be an engineering tool used by system developers. The system developers will be better able to generate information/data flow diagrams and communicate with the customers (users). If

Figure 3. Operations Flow Model A

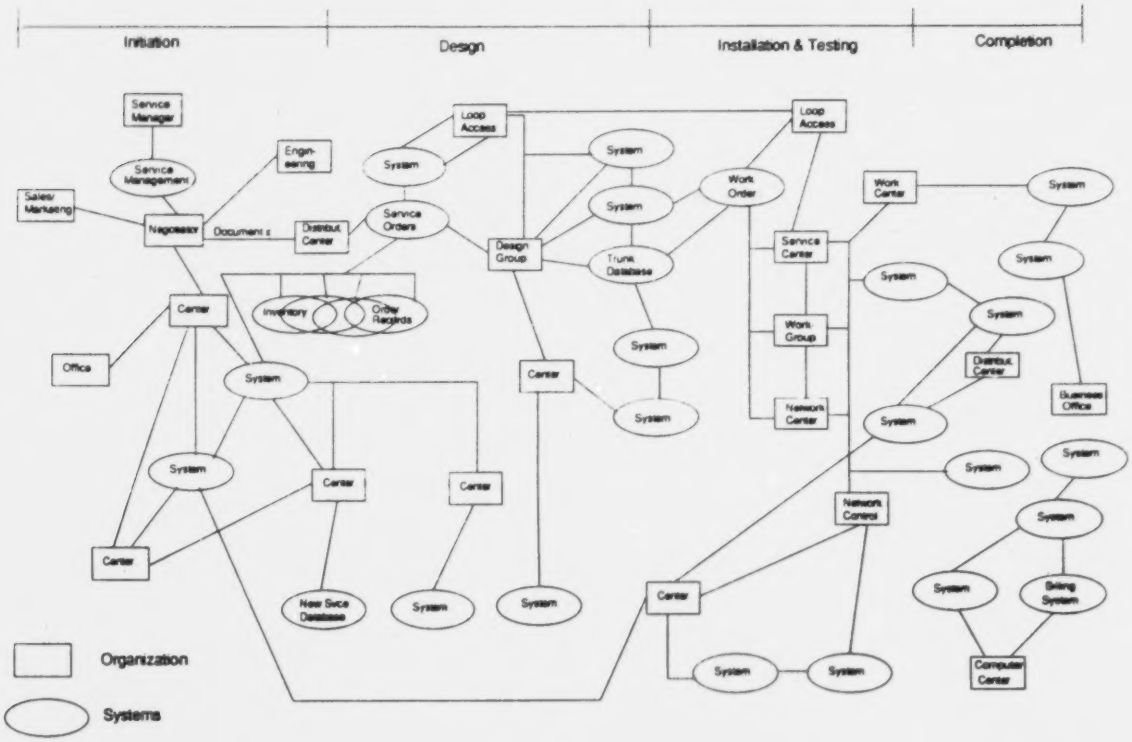
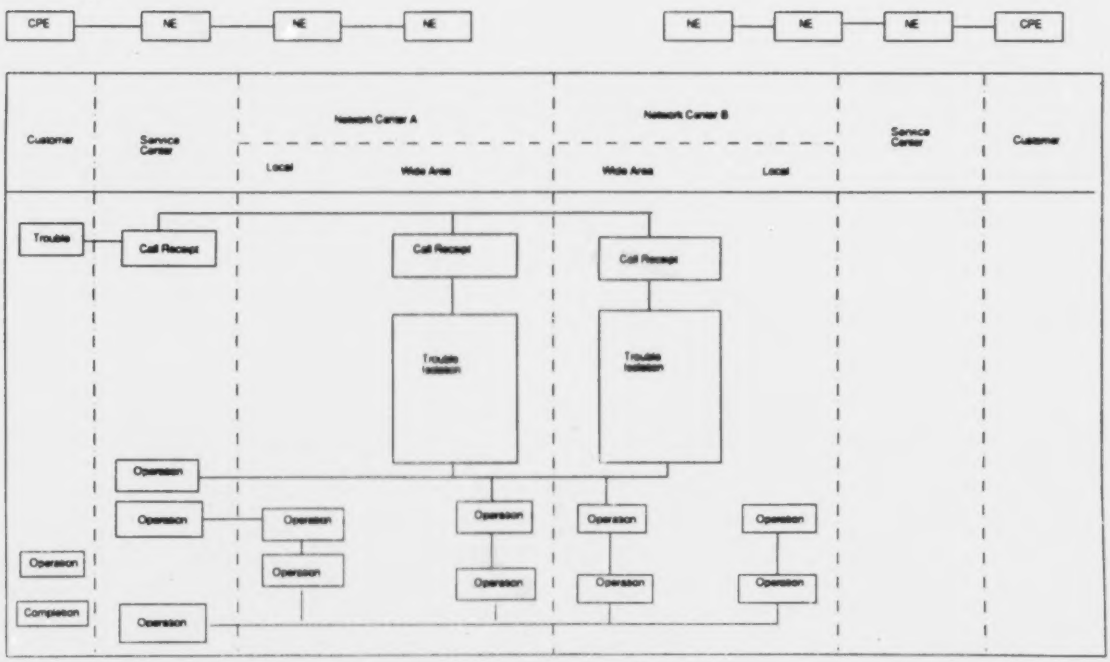


Figure 4. Operations Flow Model B



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OSAID would be presented interactively in computer graphics, it would be easier to change configurations, features, interfaces, etc.

OPERATIONS SIMULATION

An example of simulation of a provisioning process, based on an OSAID model, is illustrated in this section. The purpose of this illustration is to show that information included in OSAID can be easily extended to simulation modeling. A typical queuing simulation requires the knowledge of "customer or arrival" and "server", which are the "input" and "organization" in OSAID. Additional data are needed for simulation; they are "arrival rate", "service rate", "number of servers", etc.

Figure 5 shows a special service provisioning processes described by an OSAID. A GPSS model, which has arbitrary assumptions of data, was constructed based on this diagram. Appendix A lists the GPSS program and Appendix B shows the results after a simulation run of the program. Because the main purpose of this example is to show the use of OSAID, the data and simulation results illustrated here are insignificant. Combining OSAID and simulation, the result can be very useful either for planning or improving operations processes. Simulation generates the results of resource utilization information, such as total processing time, waiting time at each "service station" or "organization". Furthermore, simulation can generate flexible operations plans under different scenarios or system configurations.

CONCLUSION

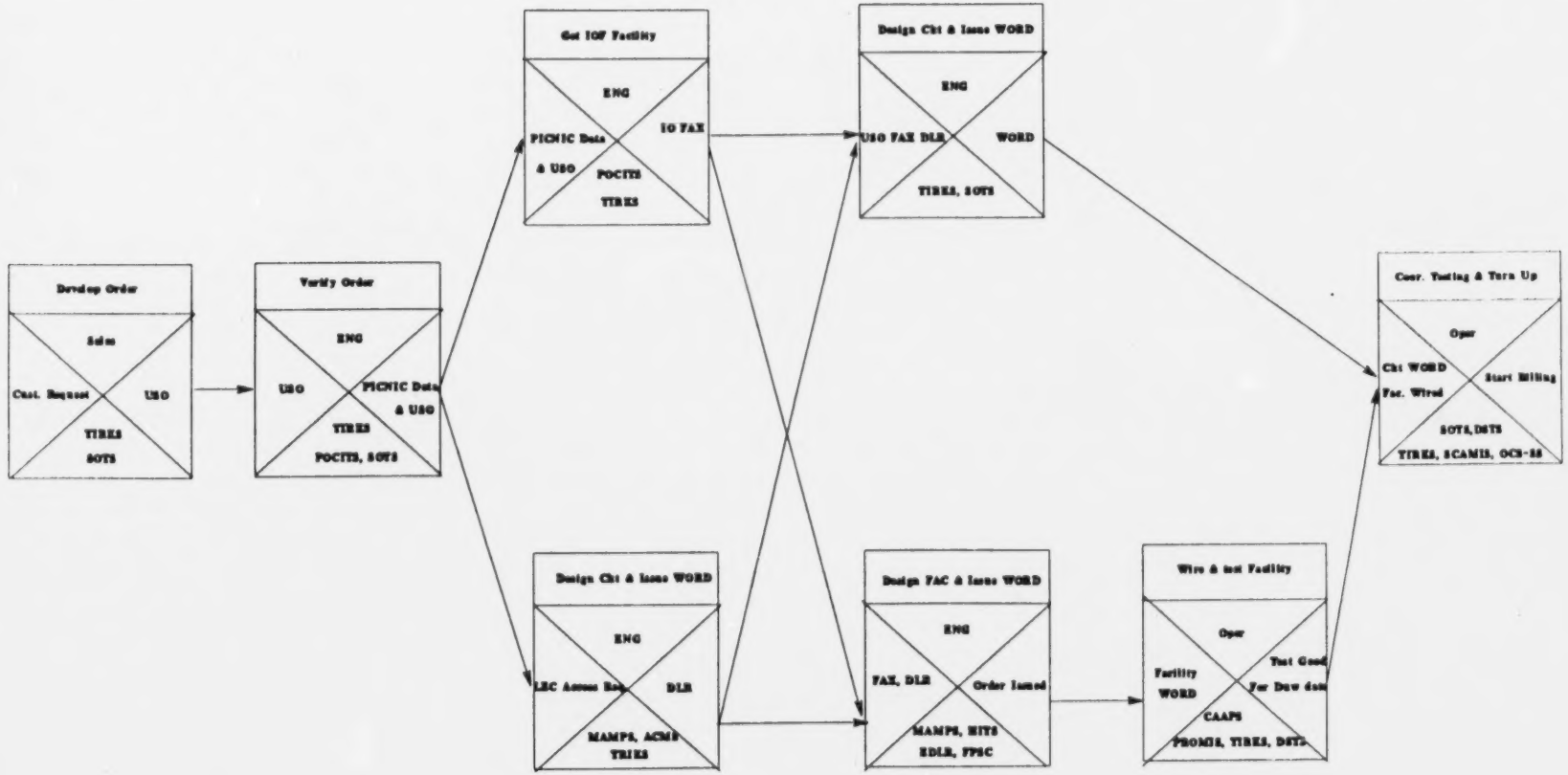
In order to understand operations processes, it is necessary to perform and practice a step-by-step analysis manually or on a computer. The OSAID methodology has been introduced to experienced and less-experienced operations planners. Experienced planners are able to better understand the methodology within a few minutes and then quickly provide information needed for OSAID. It takes about the same amount of time for less-experienced planners to understand the methodology; however, they need a little more time to construct an OSAID flow chart. Comments received from planners were mainly that the space limitation to draw the diagram itself and lack of computer graphics support.

The difficulty of space limitation has to be overcome by using more abbreviations and acronyms. As far as presenting OSAID on a PC or terminal, it is not difficult. Combining computer graphics for OSAID and simulation is really a challenge. Because of the ease of OSAID and the power of simulation, a new tool combining the two has the potential to become a very useful engineering tool. A simulation based on OSAID would deliver the following desirable results, in addition to the advantages already mentioned.

- Demonstrate quantitative benefits such as utilization levels,
- Explain changes in work processes and their impacts in a live model,
- Perform scenario analysis for different assumptions via simulation.

In order to realize if OSAID is highly valuable for operations planning, more experience should be gained in using the methodology. An organization will be benefited by widely practicing a common planning methodology such as this one. With its simplicity and flexibility, OSAID has the potential to be developed and become a tool for improving productivity of large-scale systems engineering.

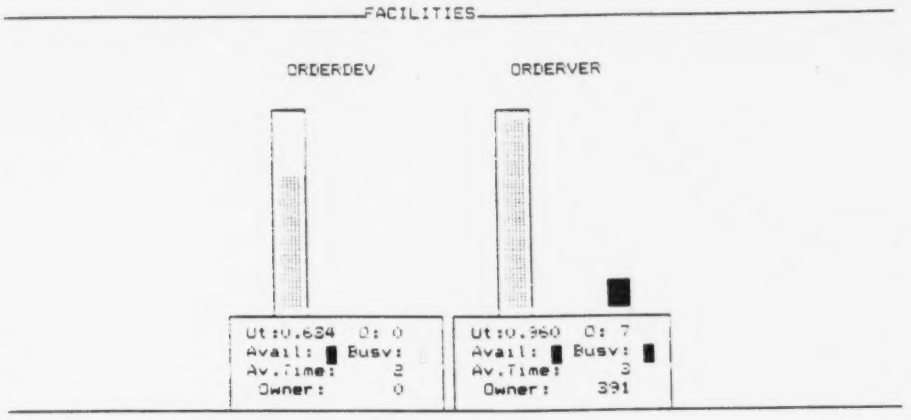
Figure 5. A Service Provisioning Model for Simulation



Appendix A. Simulation Program for Figure 5

```
:  SPSS/PC Program File LL1.  (V 2. * 38461)  10-17-1991 13:30:55
5 ******* E ample of OSAID Simulation ********
10 LINETABLE TABLE       O$ORDERDEV,2,2,10
20 LINETABLE1 TABLE      O$ORDERVER,2,2,10
25 FACIOF    STORAGE     1
30 LECDESG   STORAGE     5
35 CKTDSG    STORAGE     2
40 CKTWORD   STORAGE     3
50 ISSWORD   STORAGE     1
60 TEST1     STORAGE     5
70 FWORD     STORAGE     1
80 COOR      STORAGE     1
90           GENERATE    3,1
100          QUEUE       ORDERDEV              ;develop order
110          SEIZE       ORDERDEV              ;wait for order processing
120          DEPART      ORDERDEV              ;begin order processing
130          ADVANCE     2,1
140          RELEASE     ORDERDEV              ;finish order dev.
150          ASSIGN      LINESIZE,O$ORDERDEV
155          TABULATE    LINETABLE
160          QUEUE       ORDERVER              ;verify order
170          SEIZE       ORDERVER              ;wait for verifying
180          DEPART      ORDERVER              ;start order verifying
190          ADVANCE     3,1
200          RELEASE     ORDERVER              ;finish order verification
210          ASSIGN      LINESIZE,O$ORDERVER
215          TABULATE    LINETABLE1
220          SPLIT       1,ACCESS              ;one copy to LEC
230          ENTER       FACIOF                ;one copy to FACIOF
240          ADVANCE     2,1                   ;get IOF facility
250          LEAVE       FACIOF
260 IOF      MATCH       LEC
300          TERMINATE
310 ***********************************
320 ACCESS   ENTER       LECDESG
330          ADVANCE     5,2
340          LEAVE       LECDESG
350 LEC      MATCH       IOF
360 ***********************************
365          SPLIT       1,FWORD
400          ENTER       CKTDSG
410          ADVANCE     3,1
420          LEAVE       CKTDSG
430 CKTWORD  MATCH       WORD
440          TERMINATE
450 ***************************
460 FWORD    ENTER       ISSWORD
470          ADVANCE     3,1
480          LEAVE       ISSWORD
490          ENTER       TEST1
500          ADVANCE     10,1
510          LEAVE       TEST1
520 WORD     MATCH       CKTWORD
530 *******************************
560          ENTER       COOR
570          ADVANCE     4,2
580          LEAVE       COOR
590 ********* END ***************
600          TERMINATE   1
620          REPORT      LLPROV
700          START       100
```

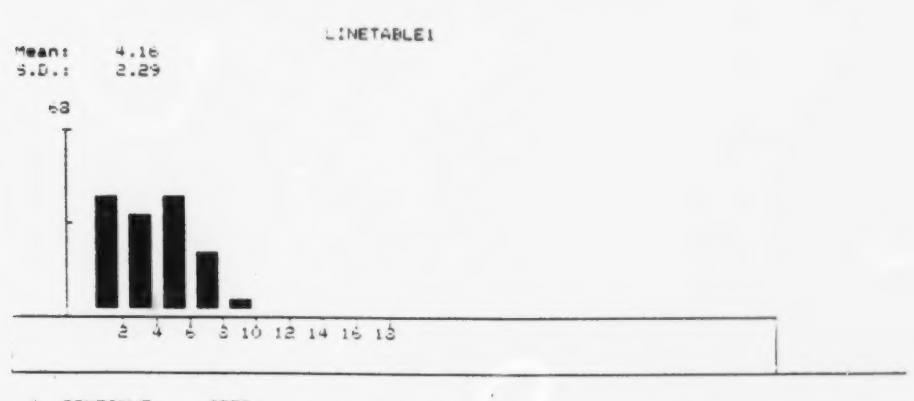
Appendix B. GPSS Generated Simulation Results (Continued)



CONTINUE STEP

Simulation Complete

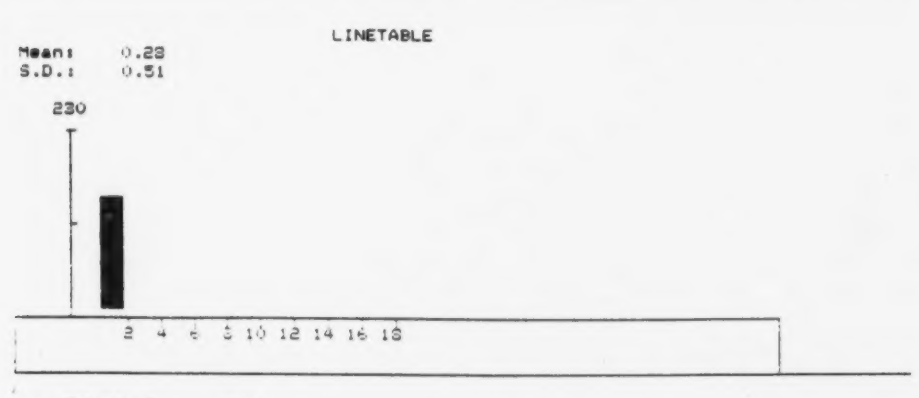
Appendix B. GPSS Generated Simulation Results (Continued)



CONTINUE STEP

Simulation Complete

Appendix B. GPSS Generated Simulation Results (Continued)



CONTINUE STEP

Simulation Complete

INTRODUCTION TO FIRE PROTECTION EMERGENCY INFORMATION SYSTEM

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ABSTRACT

A variety of natural disasters such as earthquakes,floods,and typhoons and their potential impact on a highly dense and complex urban environment have made it crucial that such services as fire and disaster prevention be able to respond quickly and comprehensively as needed.

This paper discusses the role of information processing systems in helping to ensure this required response.

1. INTRODUCTION

Japan's fire prevention administration began with municipal fire protection agencies in March, 1948. Since then, its activities have come to include far more than five prevention -- first aid, rescue services, and disaster prevention measures.

Information communication technology in fire protection application entered the picture about ten years ago. Aid from the national government for municipal fire protection activities has increased annually. The number of municipal governments seeking to upgrade fire prevention and emergency information systems has also increased.

2. OVERVIEW OF FIRE PROTECTION EMERGENCY INFORMATION SYSTEMS

This chapter explains the components and outline of fire protection emergency information systems.

2.1 System Components

The purpose of the fire protection emergency information system is to help dispatch a fire fighting team when a fire is reported so that they can arrive as soon as possible. By providing accurate information as soon as possible,damage can be minimized.

The system is integrated and contains computers, communication equipment, and peripherals. The following subsystems are closely linked with each other:

- Command subsystem (reception and command controller, and station terminal equipment)
- Computer subsystem (command control computer and information processing computer)
- Map subsystem (site locating support)
- Radio subsystem (radio control console)
- Mobile communication subsystem (vehicle location, vehicle navigation, and mobile terminals)
- video subsystem (large screen at control center)

Figure 1 shows the system configuration.

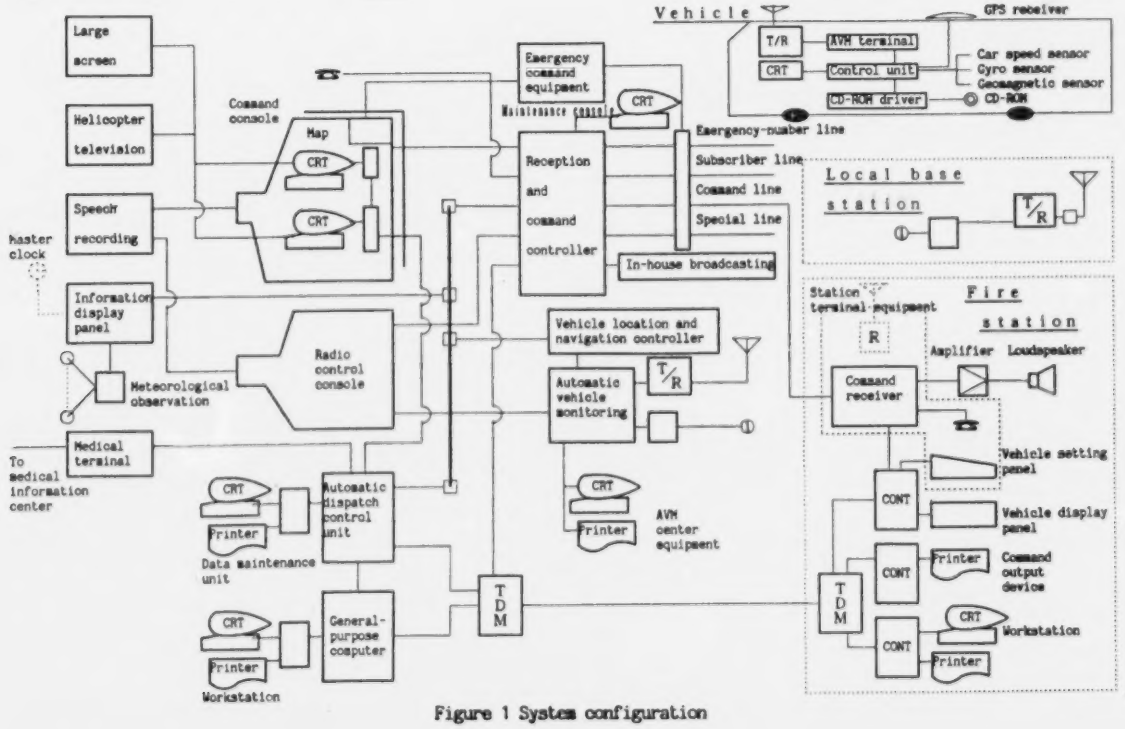

Figure 1 System configuration

2.2 Outline of Each Subsystem

The characteristics and functions of each subsystem are as follow:

(1) Command subsystem
This subsystem receives emergency-number calls and quickly sends commands to fire stations. It is an important function of the communication system.

(2) Computer subsystem
This system automatically assigns personnel and equipment to be dispatched according to the location and type of the disaster as well as disaster category information. It also supplies support information for protection activities from the fire protection information database.

(3) Map subsystem
This subsystem, displays a map of the area around the disaster when an emergency-number call is received thereby allowing the operator to pinpoint the site and determine what to do while speaking with the caller.

(4) Radio subsystem
This subsystem allows communication with the dispatched personnel. It is another important function of the communication system.

(5) Mobile communication subsystem
This subsystem allows information exchange between the center and vehicles (mobile terminals) through radio communication.

(6) Video subsystem
This subsystem displays monitors of the disaster site and computer-generated images on a large screen.

3. POINTS IN SYSTEM DESIGN

When systems engineers design fire protection emergency information systems, they must consider the following requirements:

- The fire fighting team must arrive quickly at the site.
- The information must always be accurate and up to date.
- The system must be easy to use.
- Useful support information must be quickly communicated to the fire fighters at the site.

These points are important because they affect the design of each subsystem for the integrated system.

These points are considered below.

(1) Quickness with which the team arrives at the site
The quicker the firefighting team can reach the site, the lesser the damage that is caused. This is important in system design.

(2) Accuracy of information
If the system keeps up-to-date information about the vehicles and other firefighting facilities, appropriate firefighting teams can be organized quickly when a disaster occurs. In addition, if the system has accurate information about the disaster site and other environmental conditions, the dispatched team can arrive quickly at the site. Important factors in system design include realtime collection of vehicle and other information, quick access to information stored in the center, and the building of a fire protection information database.

(3) Ease with which the system is handled
Operators must be able to handle emergency calls quickly and accurately. An important factor in system design is ergonomics.

(4) Usefulness of information supplied to the site
If up-to-date information is supplied to the site in a timely manner, the firefighting team can function more efficiently. An important factor in system design is the collection of data from a wide range of sources and a supply of dependable information obtained through analysis of source data.

The points discussed above are specific to fire protection emergency information systems. Reliability, flexibility, maintainability,and economy must also be considered for system design.

4. SYSTEM IMPLEMENTED FOR DISASTER PROTECTION

Systems engineers are always seeking the best systems using available technology. This section discusses the facilities we have implemented to fulfill the above purpose and the configuration of these system facilities.

(1) Quickness with which the team arrives at the site
We have designed and implemented a system for quick action with consideration on two points: (a) the precommand intended to start preparation for a dispatch as soon as a disaster notification comes and to dispatch a team quickly when the situation is confirmed as a disaster and (b) the dispatch command intended to allow checking of the disaster and other conditions before the team arrives at the site and to lead the team on the best route to the site.

(a) Precommands
Precommand messages are stored in the station terminal equipment. When the type of disaster and the nearest fire station are identified, the appropriate precommand message is selected to issue a precommand. Figure 2 shows the configuration for precommand issuance.

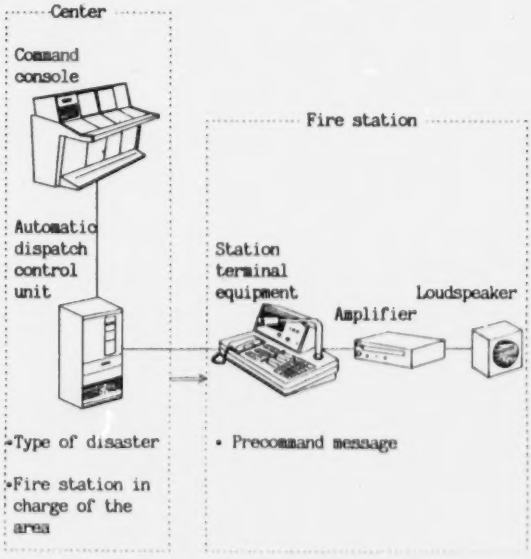

Figure 2 Configuration for precommand issuance

Precommand instance allows preparation for dispatch to start before the command is issued. This has reduced the dispatching time by five to ten seconds.

(b) Dispatch command
A command output device is installed at the fire station. When dispatching is decided on, command data is sent from the center to the fire station output device, which then outputs a dispatch command. Figure 3 shows the configuration for command output.

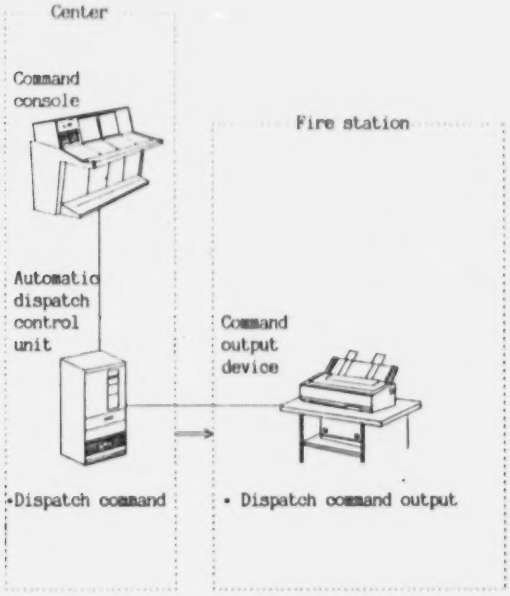

Figure 3 Configuration for dispatch command output

The output of a printed dispatch command enables people in the fire station to identify the type and location of the disaster through both voice and written instructions. A team can then be quickly dispatched.

(2) Accuracy of information
To fulfill this requirement, we designed the system featuring realtime data collection and a database considering two factors:(a) vehicle management intended to keep up-to-date information so that the most suitable equipment can be utilized when a disaster occurs and (b) support information management intended to keep information about the latest site and other conditions so that efficient dispatch and on-site activities can be assured.

(a) Vehicle management
An automatic vehicle monitoring (AVM) terminal is installed in each vehicle. It automatically transmits pertinent information about the vehicle to the center. Figure 4 shows the configuration for vehicle management.

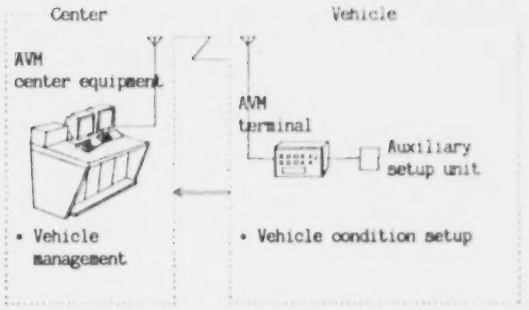

Figure 4 Configuration for vehicle management

This vehicle management feature using AVM assures detailed control of vehicles even when they are not waiting at fire stations so that teams can be organized appropriately in case of a disaster.

(b) Support information management
A workstation is installed in the fire station. Using this workstation, the fire protection information database can be accessed to update registered information, hydrant and water information, and other support information on a realtime basis. The system can thus assure the support information is up to date. Figure 5 shows the configuration for support information management.

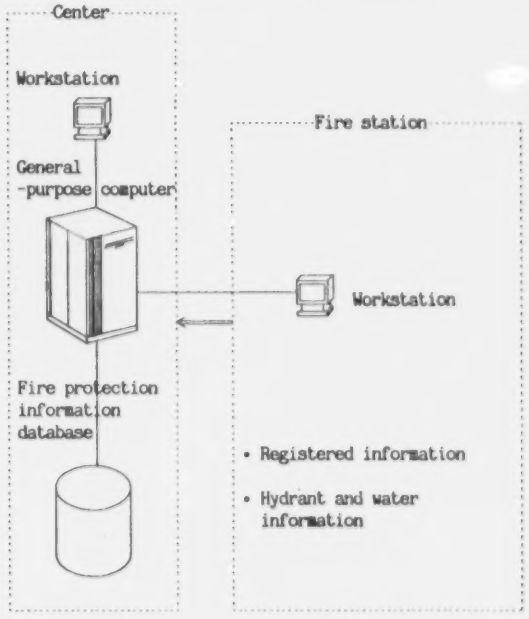

Figure 5 Configuration for support information management

This support information management feature using workstation allows realtime information management and allows efficient preparation for disasters.

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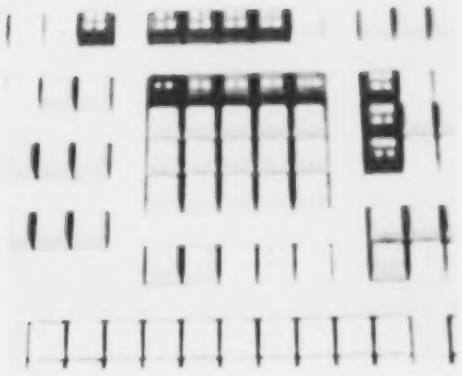

Photograph 1 Special keyboard

Photograph 2 Touch panel

(b) Plasma display
The condition of the emergency number lines can be checked at a glance on the plasma display. (See Photograph 3.)

(c) Usefulness of information supplied to the site
To fulfill this requirement, we developed (a) a tactics system designed so that video and other information can be collected and analyzed at the center and (b) a radio facsimile system designed to ensure that the results of analysis are quickly sent to the disaster site. These two features enable a wide variety of information to be collected and supplied.

(a) Tactics system
When a disaster occurs, a disaster administration board is established at the center in order to collect information from various sources and have the information analyzed by personnel of that board. Figure 6 shows the configuration of the tactics system.

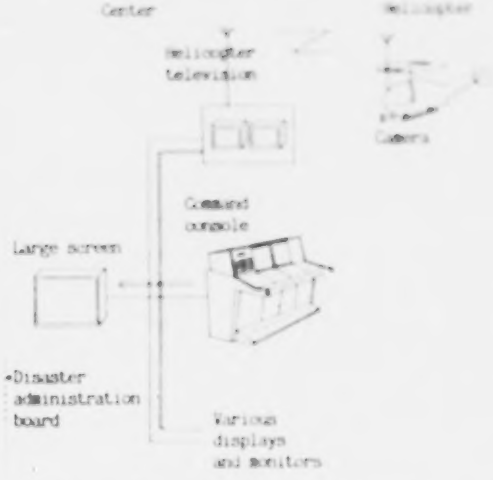

Figure 6 Configuration of tactics system

The implementation of the tactics system enables appropriate instructions to be supplied to people at the site.

Figure 1 Configuration of radio facsimile in system

The use of radio facsimile in the [illegible] shows other useful services for disaster prevention activities.

In addition, the call reception and command control equipment is backed up with spares to improve reliability. The command line to each fire station has a backup line. The software is designed so that it can be changed through system parameter adjustment.

5. FUTURE PROSPECTS

Technology advances rapidly, and it is difficult to help in unified system design schemes. It will soon become necessary to redesign the system to use better methods for vehicle location, vehicle navigation, and mobile command systems.

This system is also expected to offer integrated civil services including fire protection emergency information services and first aid and public guidance services.

6. CONCLUSION

The design of the fire protection emergency information systems have been discussed. This design was implemented in an urban area. The environment for fire protection emergency information systems is expected to change considerably in response to advances in technology.

As systems engineers, we are trying to provide better services and minimize accidents and requests from users of this system.

I hope this paper will be of help to people who design fire protection emergency information systems. We will continue our system engineering efforts to improve customer services.

LOW COST MEANS FOR GLOBAL DATA TRANSFER FOR SOPHISTICATED TECHNICAL TASKS

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ABSTRACT

The paper highlights the experiences gained by a research and development team in a developing country, working in collaboration with British engineers using self-contained electronic mailboxes. Like many other developing countries, Sri Lanka does not have a public data network and the mailboxes described in the article is an extremely useful way for data communication purposes using dial-up connections through the low grade, unreliable telephone lines. The paper highlights the details of an exercise of a Printed Circuit Board (PCB) layout transfer and the mailbox system.

INTRODUCTION AND HISTORY

Like many other developing countries, Sri Lanka does not have a public data network yet, even though the plans are underway to establish such data networks in the near future. For various requirements the users were demanded to device their own ways to establish data connections within the last decade using either dial-up connections or dedicated circuits. Most of such usages were for business purposes etc and any significant use of such data connections over international circuits for research and development activities were a rare occasion.

Almost at the inception of the Arthur C. Clarke Centre for Modern Technologies (ACCMT) - a government funded research and development centre established in honour of godfather of satellite communications, Dr. Arthur C. Clarke - was assisted by the Division of Communication Development of UNESCO. In the process the electronic mailbox described in the paper was introduced and installed at the Centre, where international direct dialling circuits were available. The project by UNESCO was to assist developing country institutions in establishing data communication links for document transfer purposes with a view to compare the mailboxes and similar devices with more expensive means such as telexes or faxes. Through the mailboxes the R&D team at the ACC was communicating with British collaborators and UNESCO officers etc regarding the daily progress of their R&D activities.

As the R&D work was very progressive at the ACC the usage of CAD packages etc were demanded for the tasks of PCB development etc. However the complex PCBs demanded for various projects particularly for the microprocessor based Data loggers designed for power line quality monitoring purposes were difficult to fabricate in Sri Lanka. At the same time deadlines demanded by the project sponsors - Lanka Electricity Company (Private) limited forced the design team to look for fabrication facilities who could complete the tasks in several days time. The PCB layout - a double sided, through hole type, which was to accommodate about five (5) VLSIs and fifteen (15) standard TTL / CMOS type chips as shown in figure 1 was created using a PC based layout package, Easy-PC, described in its User Manual in reference 1.

The layout was creating a schematic file with over 30 K bytes of data. At this stage the British collaborators were having access and the experience with a PCB fabrication facility and were convinced that the PCB could be available before the deadline if the layout was available in its final form in UK. The mailbox described in the article being capable of binary file transfer, an experiment was conducted to evaluate the success of using such inexpensive means for sophisticated tasks.

MAILBOX USED

The mailbox shown in photograph of figure 2 was designed to serve two independent purposes. It is an error-proof high speed duplex data link between a computer and a remote terminal or second computer, and is also an electronic mail service with off-line message entry and automatic delivery.

When used as a Modem, the unit provides auto-dial and auto-answer, and the protocol which it uses offers error-free communications even over bad lines. The only trade-off is that the speed falls if the line is of poor quality.

Conventional electronic mail systems depend upon the use of a central computer, accessed by simple dumb terminals over an unprotected asynchronous link. This system requires no central computer and the messages are delivered directly from one mailbox to another, where they are held in battery-backed semiconductor memory.

A flashing led indicates that mail has been received. There is never any need to call a central bureau to find out whether any messages

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have been left: the recipient has the message there in his mailbox and the sender has a reliable acknowledgement of the delivery.

Furthermore a message is not marked as 'delivered' in the sender's unit until every character has been checked and confirmed correct in the destination mailbox. Several levels of error recovery procedures, acknowledgements and interlocks are used to make the system very reliable.

The sender and recipient of mail both interact with their mailboxes off-line (figure 3). Actual transmission of the mail is normally performed fully automatically at night. For a typical short message the telephone call lasts only a few seconds, which at cheap rate means that the cost is less than that of a second class letter (in British Isles). The total capacity available for storage of message text is 52 Kbyte.

All telephone lines are liable to be noisy, and so all simple Modem standards are prone to errors which make terminal use frustrating and file transfer difficult, without running special protocol software in the host computer at each end of a link. Electronic mail is most useful and habit-forming facility to have access to, but it usually depends upon the use of either a central computer or compatible hardware and software at each node.

Physically, the system consists of a single Printed Circuit Board which contains a microprocessor with 64 Kbytes of memory, a battery-backed real-time clock and a 1200 baud Modem. External connections of the unit are mains input, telephone line and an asynchronous RS232 line to which either a terminal or a computer can be connected.

Several methods of originating and answering telephone connections, either automatically or manually are provided. Whenever the mailbox is on-line to another such system there is a duplex link open between the two terminal connections which is independent of the mail system. When off-line, the terminal line can be used to enter messages (or even binary files) for later delivery to another node, and to read incoming electronic mail.

Each mailbox is given a unique name, and the mail delivery system is based on these names rather than on telephone numbers. Three levels of delivery service are provided. First class mail is sent at once, second class mail is sent overnight and third class mail is sent only when the opportunity arises.

Whenever two units are connected, they exchange names and each scans its list of mail to see if it has anything to send to the other one. Any opportunity to transmit mail is always taken advantage of.

The mailbox uses a 1200 baud half-duplex standard (CCITT V23) with provision for fast direction switching. The HDLC link-level protocol chosen, with a variable packet size of upto 64 bytes.

The half-duplex system requires an extra 32 bytes in order to transmit 64 bytes of user data. This may seem a lot, but it includes the time spent in switching line directions, locking up the receiver clocks and sending the necessary error detection and link house keeping information. The return for this reduction in data rate to two-thirds of the line bit rate, one is guaranteed that the data will be received with an error rate which is independent of line quality and which is so low as to be for all practical purposes non-existent. Standard XON / XOFF characters are used, which are recognized already by most operating systems. Separate provision is made in both real-time link and the mail system for the transparent transmission of arbitrary 8 bit binary files. Under all normal circumstances there is no detectable limitation on the speed at which a terminal user is allowed to type in to the system. Figure 3 shows the mailbox functional diagram. For usage information and detailed technical information on the mailbox reference 1, 2 and 3 are suggested.

The latest versions of the mailbox ME43 and ME44 use an integral software package 'MailMan'. The program is for use with IBM PCs and compatibles, and allows the users to organize mail messages sent and received by the mailbox. All day-to-day management of the mailbox is handled by the MailMan software. Although the software is not copy protected, each copy of MailMan is specifically configured for use on a single Mallard Mailbox.

USE OF A DATA COMPRESSION TECHNIQUE TO SAVE TELEPHONE BILLS

In the particular data transfer experiment in order to save the IDD telephone bills a standard data compression technique based on Lempel-Ziv-Huffmann algorithm was utilized. This helped reducing number of bytes be transferred from over 30 Kbytes to less than 18 Kbytes. This made a very reasonable saving on the telephone bill, and only approximately 6.5 minutes of connection time was used. For the details of the compression technique one may refer to reference 4.

REMOTE END ACTIVITIES

At the remote end UK, the graphics layout was transferred on to a similar mailbox (named MEA) from the mailbox at ACCMT (named ACCENT) totally error free. Decompression of the graphics layout recreated the total PCB layout on the remote PCs. The final error free PCB layout was later transferred to a PCB fabrication facility where the PCBs were to be fabricated. At the remote end the received PCB layout was checked (for reconfirmation purposes) using the same PCB layout package used by the Sri Lankan team. Fabricated PCBs were received in Sri Lanka through a courier service well before the deadline demanded.

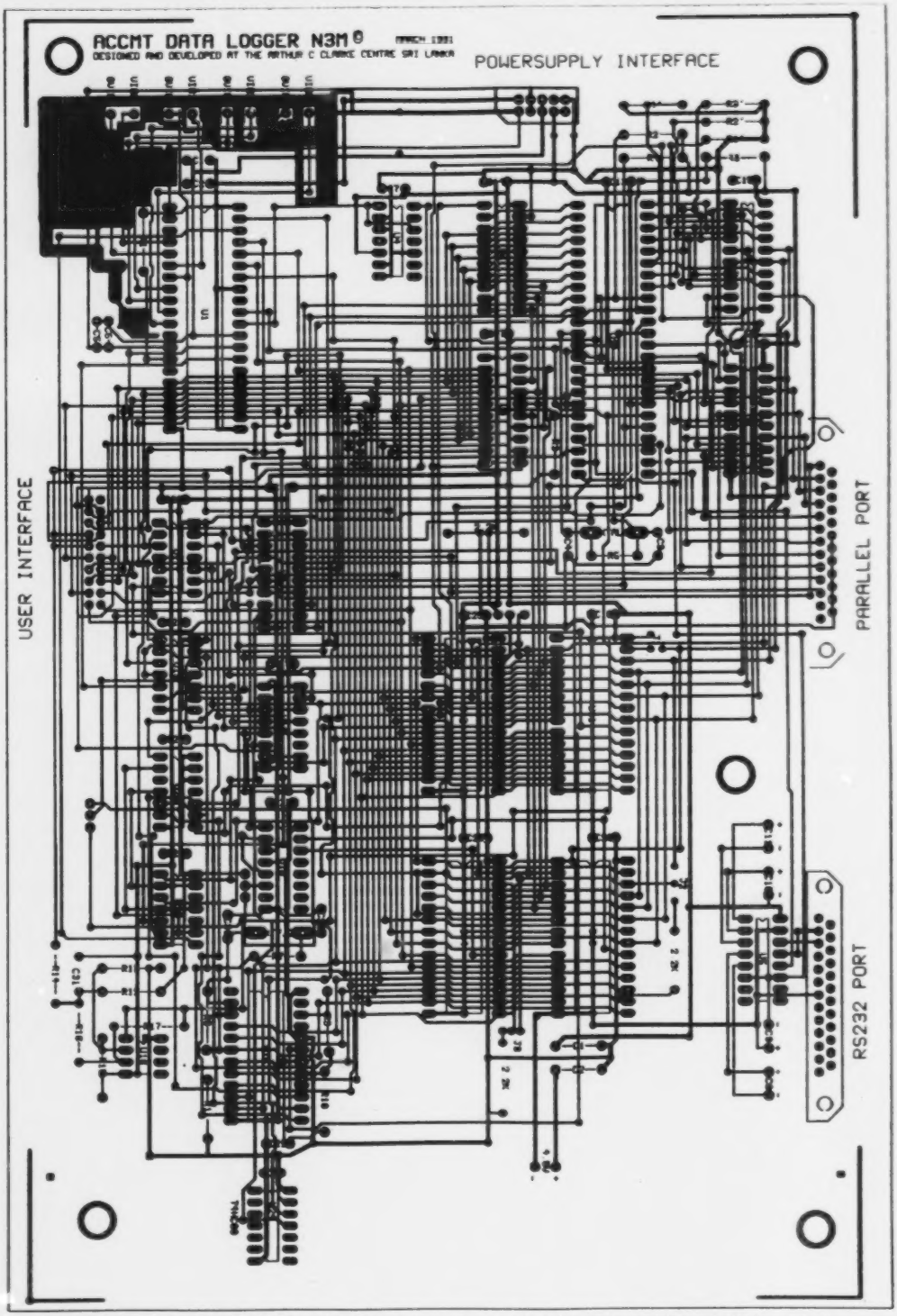

FIGURE 1 - The Printed Circuit Board layout - a double sided, through hole version which was transferred via mailbox experiment. Note that the diagram shows both sides of the PCB together.

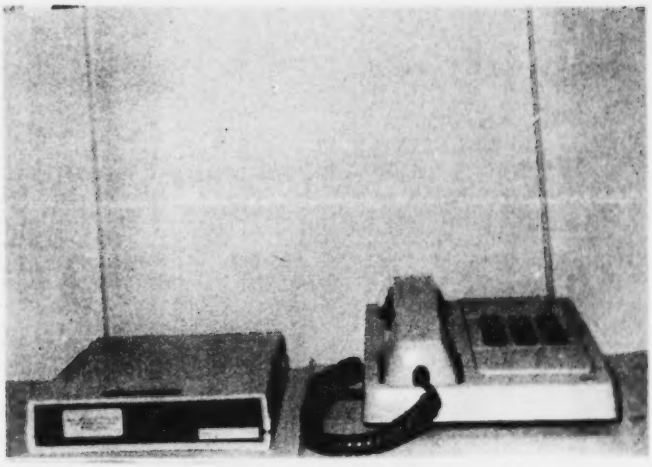

FIGURE 2 - The Mailbox Used

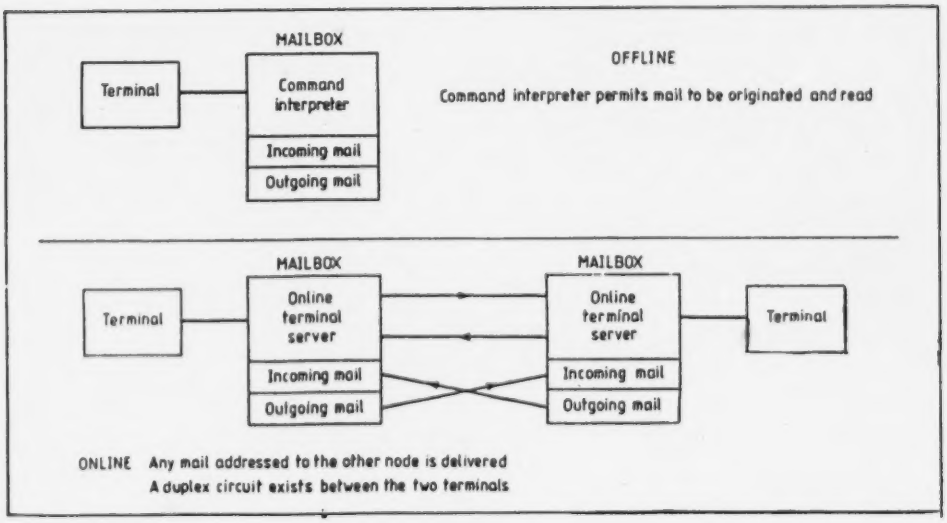

FIGURE 3 - Mailbox functional diagram. Outgoing messages are entered into the mailbox from a terminal or computer through an RS232 link. Software in the mailbox makes entering the message very simple. One may send the message immediately or leave it to the mailbox to send it later on, when calls are at cheap rate. Using 'third-class', the sending mailbox only sends its message when the destination unit makes contact - which is even cheaper.

EXTENDING THE USE OF MAILBOXES FOR OTHER SOPHISTICATED TECHNICAL TASKS

The design of the mailbox allows the binary or ASCII file transfer totally error free and could be used for sophisticated tasks where an average fax, telex or even a standard and popular e-mail connections do not permit. The approach used in the particular experiment was to transfer the graphics layout / binary file on to an identical mailbox and from which the files could be manipulated again with the identical PC packages for further engineering tasks be carried out. The experience well proves that the graphic files created by common packages such as Auto CAD etc are easily transferable (internationally) using the mailboxes. The other advantage is that the unauthorized access to the data is not easy, due to inherent security features on the mailbox. The telephone company charges involved are only the call charges and does not demand any subscription charges for gateway access or network services.

SUMMARY

The experience gained by the developing country R&D group and the British engineers team indicated that the self-contained mailboxes described in the article can be easily used as a cost effective alternative to the use of public data networks or leased lines, for graphic file transfers and similar tasks.

ACKNOWLEDGEMENT

Authors gratefully acknowledge the efforts of the Research Engineers of the ACC - Parakum Fernando, Nihal Samaraweera and Manjula Ellepola - design team members of the Data Logger project for their kind assistance.

Our sincere gratitude is to Dr. Carlos Arnaldo of UNESCO who assisted in the funds needed for the fabrication of PCBs in a UK facility.

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Government Information Services and Telecommunication Technology in the Pacific Islands: Using the Iowa City Information Services Model

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University of Wisconsin-Stevens Point

Ronnie Bankston
University of Northern Iowa

This study is concerned with how governments use information technologies, such as the telephone and television, to provide information to its citizens. After providing a case study of the Iowa City Government's Information Service, this study, using Guam as an example, speculates that an economical and technologically realistic approach for Pacific Islands governments' dissemination of information is readily available for adaptation.

> "With the availability of greatly expanded electronic communication facilities, better access with less delegation of authority could be provided. With a more informed public and with the possibility of automatic opinion sampling or voting, a much greater degree of direct participation at all levels of government would be available... It could lead to great social understanding and greater access to and transfer of information while improving the opportunities for both freedom and privacy!"
>
> J.L. Holt, "Cheap Communications," The Futurist, 1969

Over the past decade and a half, information technologies have undergone an explosive growth and rapid diffusion in numerous Third World and Developing Countries around the world, including the Pacific Islands. Although the adoption of many inventions and innovations varies depending on systematic, contextual, and aggregate reasons, television and telephone technologies are usually among the first adopted and diffused. Information dissemination through technological means is usually seen as a legitimator or motivator, a political "lightning rod," an accelerator of interaction, an organizer and maintainer, an institutional catalyst, and as a means to improve the physical qualities of life.

Historically, the adoption of information technologies has evolved as the technologies have evolved; from the press to the telegraph to telephone to radio (wired and wireless) to television (broadcast and cable) to videocassette to the computer. The successes of such technological adoption for information dissemination have varied, depending on a variety of reasons, including how the term "success" is defined. Out of such concerns, the notion of "appropriate technology" evolved. Essentially, appropriate technology calls for the adoption of information technologies that are appropriate for the political, economic, and social variables present in a developing or third world country.

This study is concerned with how governments can utilize the technologies of the telephone and television to provide and disseminate information. After a review of the Iowa City Government's Information Service, which utilizes cable television and touch tone telephone technology for an interactive information system, this study suggests that implementation of such a system among Pacific Island nations would be economically and culturally appropriate.

GOVERNMENT INFORMATION CHANNEL 29

The City of Iowa City, the Iowa City Cable TV Office, and the Iowa City Broadband Telecommunications Commission are trying to marry television, telephone, and computer technologies. As a result, residents of Iowa City and Coralville, Iowa have access to an interactive video system that provides a wide range of community information cagegories. Housing information, job opportunities, community calendars, and election information are only an interactive session away.

System Development

In 1980 Drew Shaffer, a cable television specialist for the city, and several friends began to develop an interactive video system. The partnership, known as Response Television Corporation, pursued the project during the early and mid 1980's. In 1986 Shaffer met city officials to discuss the possibility of testing the system in Iowa City (1). Later that year initial tests were conducted with a minimal number of categories and screens. The system continued to operate in this experimental mode until 1989 when an interactive specialist was hired and the number of information categories increased. Since 1989 the number of information categories, screens, interactive sessions, and project staff have increased significantly.

System Design

Government Information Channel 29 is a single-user system that does not require a home decoder or keyboard. The user only needs a touch-tone telephone and a television set to interact with the system.

On the sender end, the system is tied to an Amiga 2000 computer and a software package developed by Response Television Corporation. Information is distributed from the computer to the cable system via a genlock and modulator.

1. The user turns his or her television set to cable channel 29. Users with cable-ready sets will tune in channel 30.

2. The user will call 356-5478, which is the information services phone number.

3. Hardware developed by Response Television Corporation decodes the phone signal and directs the user through the software.

4. The user will watch the television screen for directions. Information can be requested by pushing designated telephone buttons.

5. The computer will generate the desired category and screen, which is distributed on the cable system to the user and anyone else that is viewing the channel.

6. An interactive session, which is recorded by a computer, can last three minutes. The session's backtime, which is the amount of time left in the session, will be displayed at the top of the television screen.

7. A three-minute session will be terminated by a computer generated voice that says, "Bye, and thanks for your interactive use."

Information Categories

The system started with only four or five information categories and approximately fifty screens. This limited menu allowed users to gain access to city council agendas, commission meeting agendas, and information about access programming (2). By the fall of 1990 the system had expanded to over twenty-five information categories (3). Users could now gain access to information about taxes, elections, missing children, jobs, recycling, bus routes, jokes, and cartoons.

As system awareness and usage

increased new information categories emerged and existing categories were allocated more screens. In the last year the system has expanded at an unbelievable rate. Today there are over seventy categories available to users.

1. YOU TELL US (Interactive Poll)
2. DIRECTORY OF INFORMATION CATEGORIES
3. INSTRUCTIONS
4. PARKS AND RECREATION
5. CITY NEWS
6. CITY COUNCIL AGENDA
7. VOTE- POLLING PLACES
8. VOTE- UPCOMING ELECTIONS
9. VOTE- ELECTION RESULTS
10. VOTE- ABSENTEE BALLOTS
11. VOTE- WHO CAN VOTE?
12. VOTE- HOW TO REGISTER?
13. TAXES
14. CITY BUDGET
15. INCOME TAX INFORMATION
16. SCHOOL- LUNCH MENUS
17. SCHOOL- B.O.D. MEETING AGENDA
18. SCHOOL- HIGH SCHOOL SPORTS SCHEDULES
19. SCHOOL- MISSION STATEMENTS
20. PUBLIC SERVICE ANNOUNCEMENTS
21. FBI WANTED POSTERS
22. IOWA CITY POLICE: APB
23. IOWA CITY POLICE: CRIME PREVENTION
24. IOWA CITY POLICE: RADAR LOCATIONS
25. MISSING CHILDREN
26. TOWLIST
27. PARKING METERS
28. ANIMAL SHELTER- PET REGULATIONS
29. ANIMAL SHELTER- PET CARE
30. ANIMAL SHELTER- HOW TO ADOPT A PET
31. ANIMAL SHELTER- LOST AND FOUND PETS
32. ANIMAL SHELTER- PET HEALTH INFORMATION
33. GIC PROGRAM SCHEDULE
34. JOBS: CITY OF IOWA CITY
35. JOBS: JSI- IOWA CITY
36. JOBS: JSI- CEDAR RAPIDS
37. JOBS: UNIVERSITY OF IOWA
38. JOBS: VOLUNTEER OPPORTUNITIES
39. CABLE SUBSCRIBER INFORMATION
40. BUS ROUTES & SCHEDULES
41. BUS FARES
42. BUS- HOW TO GET THERE
43. TOLL FREE PHONE NUMBERS
44. ABOUT GIC
45. JOKES
46. CARTOON
47. ZODIAC
48. FUN FACTS
49. MAZE
50. ELECTRONIC ART GALLERY

51. WELCOME- HEALTH SERVICES

52. WELCOME- LIBRARIES/MUSUEMS

53. WELCOME- AREA EVENTS

54. WELCOME- TRAILS IN EASTERN IOWA

55. WELCOME- KIDS STUFF

56. SENIOR CENTER- ACTIVITIES

57. SENIOR CENTER- MOVIES

58. SENIOR CENTER- FAMILY ALBUM

59. RECYCLING- GENERAL INFORMATION

60. RECYCLING- LOCATIONS

61. RECYCLING- HOUSEHOLD WASTE

62. HOUSING- TEMPORARY HOUSING

63. HOUSING- REHABILITATION

64. HOUSING- HELP FOR RENTERS

65. HOUSING- ELDERLY AND HANDICAPPED

66. HOUSING- LEGAL ASSISTANCE

67. HOUSING- C.H.A.S.

68. TOURS OF IOWA CITY

69. SAFE SEX- AIDS

70. SAFE SEX- CONDOMS

71. SAFE SEX- SEXUALLY TRANSMITTED DISEASES

72. SAFE SEX- WHAT IS SAFE/NOT SAFE

73. SAFE SEX- PHONE NUMBERS FOR MORE INFORMATION

74. SIGN LANGUAGE ALPHABET

The information categories are updated continually. Categories that are time sensitive require more maintenance. For example, job categories must be updated at least once a week, while bus routes may need little or no attention for a six-month period (4).

Usage Patterns

Government Information Channel 29 is expanding very quickly. However, the pattern of usage appears to be somewhat constant over time. Viewer usage data for the week of October 6-12, 1990, indentifies the Directory, Cartoon, Zodiac, interactive poll (You Tell Us), Ivy, Fun Facts, Radar Locations, Jokes, Welcome to Iowa City, and Instructions as the top ten categories (5). Viewer usage data for the first quarter of 1991 identifies the Directory, Jokes, You Tell Us, Fun Facts, Cartoon, Zodiac, Interactive Maze, FBI Wanted Posters, Instructions, and Radar Locations as the top ten categories (6).

These usage patterns might indicate that system users are going through an experimental stage and/or prefer the entertainment categories of the system. Thus, the information obtained may not be as critical to some users as the interactive process itself. However, increased usage in the jobs, recycling, and city news categories indicates a demand for more "serious" information.

While the pattern of usage has remained somewhat constant the number of interactive sessions have grown significantly. Between January and March 1990 approximately 1500 calls were made to the system. During the same time period in 1991 system use had grown to approximately 10,000 calls (7). As of September 1991 the system was receiving between 800 and 1000 calls per week (8).

Future Plans

At the present time the system is available whenever city government programs are not being broadcast. Thus, channel 29 is used primarily for the interactive video system. However, the rapid growth of the system warrants a separate channel. This option is under consideration at the present time.

As the system continues to expand,

via a separate channel or in a shared-channel capacity, Schaffer and his staff will add and delete information categories to meet community needs, examine ways to make the system more accessible to users, and maintain localism as a primary operating principle.

The Information Services Model in the Pacific:
A Case Study of Guam

The marriage of the computer with cable television and the telephone in Iowa City has given the city government a unique opportunity to provide information to the community. The amount of such information available is limited only by the ability and desire of the city government to provide materials. Access to the information is easy to gain and convenient to the user.

Countries or cities with cable television systems in operation would be able implement the model with a relatively low capital investment. Costs would be limited primarily to the software package, computer, modulator, and gen lock hardware, an incoming telephone line, and the staff required to input and update the information materials.

Because the Pacific Islands have a high rate of urbanization, due to small, often-time mountainous land areas involved, cable television becomes an ideal distribution technology for government information. Guam provides a good example of how the information services model might be implemented.

Guam, a territory of the United States, has approximately 135,000 people for a land mass of 209 square miles (9). Approximately one-third of the land is owned by the U.S. Armed Forces and the majority of the population is concentrated in the vicinity of the capital. English is the official language, although the majority of the residents are of Chamorro, Filipino or Micronesian descent. U.S. military personnel and ex-patriots comprise the remainder of the population. The tourist trade is second only to the U.S. military in economic importance. There are some agricultural and light manufacturing industries which also contribute to the local economy as do the more than 13 banks and 7000 government employees.

Given the variations in the economy and ethnic backgrounds of the population, the methods by which the Government of Guam disseminates information become crucial if the information is to reach the intended audience. With a cable television system already operating, using the information services model would seem an appropriate dissemination technique.

Cable Television on Guam

> "The Guam Cable T.V. system is probably the most significant cultural medium on the island today... the cable phenomenon began in 1968... and now reaches to all parts of the island, including military installations. Indicative of the system's popularity, the requirement to have a specific home address for cable service has probably caused the greatest impetus to having house numbers in many villages" (10).

The Guam Cable T.V. Company has over 580 miles of cable which pass by roughly 33,000 homes; about 90% of homes in the area (11). There are over 25,000 suscribers; about 75% of the homes in the area. The system has the capacity for 35 channels and currently operates 8 television and 4 pay cable channels. The basic cable also includes 10 channels, such as CBN, Discovery, ESPN, MTV, etc. The system also has 5 originated channels for classifieds, a program guide, live legislative sessions, hotel entertainment, and news and community events (12).

The high cable penetration rate and the diverse needs of the Guamanian population provide an almost perfect "setting" for the Information Services Model. The interactive ability of the model provides the consumer the opportunity to choose from the various

information categories. The almost unlimited number of information categories could allow the Government of Guam to program information sensitive to the diverse needs of the population. Some categories might include: agricultural information, voting information, weather information, hotel entertainment, tourist information, police information, tax information, job information, church information, transportation information, U.S. government information, historical information, housing information, health information, land information, political party platforms, and so forth. The information categories could be programmed in different languages, thereby allowing for non-English reading citizens access to the materials. In short, the information services model can provide for the Government of Guam a relatively low-cost, technologically realistic method for disseminating materials to meet the information needs and desires of its citizens.

Some Concluding Remarks

The Pacific Island Nations represent one of the most diverse regions of the world in terms of politics, languages, governments, and cultures. The political entities represent various stages of dependence and independence while the economies are usually very heavily dependent upon one export commodity, tourism, and development aid. The people, languages, cultures, and requirements of those cultures are as varied as the names of the Pacific Island Nations suggest. The implementation of the Information Services Model could help the governments to meet the needs of their citizens.

Because the Information Services Model utilizes cable television for information dissemination, there needs to be a high rate of urbanization present in order for the cable system to be economically viable. Many Pacific Island Nations have urban, capital centers with operating cable systems and rural areas (sometimes separate islands 600-700 mile distant) without access to a cable television system. In such cases, cable television distribution is not economically viable. The recent trend, however, towards the deployment of fiber optics across the Pacific could render such physical distances obsolete. Indeed, some optimistic projections suggest that within the next decade, fiber optics will replace coaxial deployment completely for all telecommunication services. If this happens, the Information Services Model could provide an appropriate technological means for dissemination of government information to all portions of the country; urban and remote.

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(2) Shaffer, personal communication, 1 October 1991.
(3) City of Iowa City, "Channel 29 Interactive Information Services Viewer Usage Data Analysis," 27 March 1991.
(4) K. Svetvilas, "They serve information to order via TV," Iowa City Press Citizen, 8 February 1991, p. B1.
(5) City of Iowa City, 1991.
(6) City of Iowa City, "Information Services Quarterly Report for the Third Quarter of FY91," 30 May 1991.
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The Trend of Voice Message Services in Advanced Information Society

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ABSTRACT

The information science in the modern world is changing with dizzy rapidity. For communications infrastructure, telephone networks play a major role as the core of information-oriented society.
The changing world demands more and more value-added services to be provided through telephone networks, in order to cope with user's diversifying needs, rather than the assurance of transparent communications services required for the conventional telephone networks.

This paper discusses the trend and some instances of voice message services in Japan, in particular, to infer a would-be destination of the future telephone network development.

1. INTRODUCTION

Since 1985, three new common carriers launched their operations as part of communications infrastructure, following Nippon Telephone & Telegraph Co. Ltd. (NTT) who had been monopolizing the role of Japan's communications infrastructure for telephone services.

Telephone networks are basically and critically required to provide the integrity of speech. For this reason, conventional telephone networks are operated basically for providing transparent communications services.
As the information-oriented society advances, however, telephone networks are being required to provide audio database service and other value-added services to overcome the time-lag in communications.

2. THE TREND OF VOICE PROCESSING EQUIPMENT TECHNOLOGIES

Voice processing equipment is an indispensable tool for the implementation of value-added services through telephone networks, since the communication media is basically human voice.
The voice processing equipment consists of "Audio Database Equipment" primarily for voice mail services and "Voice Response Equipment" for interactive communications with telephone sets as computer terminals.

NEC marketed its VS-series voice processing equipment in 1983, featuring easy connection to existing telephone networks, and is capable of implementing various services by the host computer control.
The authors will introduce the trend of Japan's voice processing equipment technologies on the basis of the preceding voice processing equipment.

2.1 VOICE ENCODING AND DECODING TECHNOLOGIES

Japan's voice processing equipment commonly employs Adaptive Differential Pulse Code Modulation (ADPCM) to obtain higher quality of sound.
The current bit compression widely ranges from 8 Kbps to 32 Kbps.
With the recent technological development, the technology for 8 Kbps has already been proven for laboratory use.
Most manufactures, however, employ a bit compression of 32 Kbps, since they give more weight on the sound quality.
The use of optical disks is being implemented by some manufacturers, although hard disks are commonly used as media for the memory of compressed voice.

2.2 PROVISIONS FOR VOICE INPUT

The use of voice processing equipment is required to give an instruction to the equipment for a service to be provided.
Normally, the user's instruction is given by sending telephone push-button dialing signals, so that nearly 100% correct recognition rate can be attained.
Unlike the United States, only 30 percent of the total telephone subscribers in Japan use push-button dialing telephone sets and the remaining 70 percent use conventional rotary dialing telephone sets.

Since Japan's public telephone networks do not have a function for the direct transmission of rotary dial pulse signals, signal conversion equipment capable of converting a rotary dial signal into a push-button dial signal is required in order for the voice processing equipment of push-button dial signaling system to receive rotary dial signaling instructions.

Many types of multi-function telephone sets now available in market use the rotary dial pulse for call origination, and transmit the push-button dial signal on and after the call setup.

It is considered that in Japan the availability of such technologies allowing the equipment to receive the rotary dial signaling

instruction would be a key factor to the successful implementation of various value-added services with the voice processing equipment.
The preceding signal conversion equipment for changing the rotary dial pulse signal into the push-button dial signal is already available in Japanese market, but not ready yet for general use because of some problems existing in the recognition capability.

In the long run, it is suspected that the natural human voice will be used for the input by voice recognition, in place of the use of a telephone function. (sending of push-button dial signal or rotary dial pulse signal)

It is conceived in the short run that the input of push-button dial signals will co-exist with that by the voice recognition for the time being. For voice articulation, it is expected that the intensive packets of superior technologies, such as single-sound synthesis and syllabling technique, will be put to practical use.

3. THE TREND OF VOICE MESSAGE SERVICES

In the United States, voice mail services are widely utilized among business firms as a means of overcoming the time-lag.
A type of information services, known as the "900s" information service, is generally accepted by many users as a voice message service.

In Japan, the development of the voice response service that communicates interactively with computers preceded that of the voice mail service, because no time-lags are geographically applicable in Japan.

NTT launched so-called "Dial Q" service, one of NTT's numerous services, for allowing contractual information providers to send required information to their customers via telecom circuits (telephone, videotex, etc.) and for collecting information charges on behalf of the information providers. This service is equivalent to one of the "900s" services in the United States. This triggered the rapid spread of voice mail service in Japan and its marketability indicates a promising expansion.

The following figures shows how fast "Dial Q" service has been developed in Japan:

Period	Number of programs put on mass media	Sales
March 1990	166 programs	$1 million/month
July 1990	600 programs	$10 million/month
March 1991	10,700 programs	$100million/month

In the not-distant future, a composite service, a combination of "voice processing equipment" with other media (e.g. facsimile mail and electronic mail), will be rapidly developed for practical use.

4. SOME APPLICATIONS OF VOICE MESSAGE SERVICES

Introduced below are some applications of the voice message service in Japan.

4.1 VOICE MAIL SERVICE WITH PAGER FUNCTION

This service is provided in the following way; by recording a message on the audio database equipment and giving the pager number of a called party, the audio database equipment will automatically call up the pager so that the owner of the called pager can call up the audio database equipment to receive the message.

Because the message is conveyed directly by human voice in place of conventional messaging in the form of a memo, there will be no room for making an error in message transmission, in addition to the merit in additional messaging effect by a specific tone of voice; for instance, a critical situation can be conveyed with such a tone of voice.

This service is effectively utilized among business firms; for instance, when communicating with sales persons working outside or when communicating with each other among sales persons.
Some companies in Japan are doing their business by providing this service.

A system configuration for the voice mail service with a pager is shown in Figure 1.

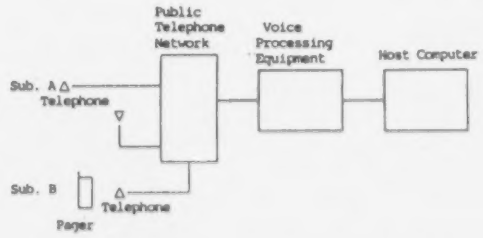

Figure 1 SYSTEM CONFIGURATION FOR VOICE MAIL SERVICE WITH A PAGER

4.2 SEAT RESERVATION SERVICE

This is a service to be provided for seat reservation by telephone, as is seen in railroad, airline, and long-distance bus services.
In either service, a telephone set is connected via a public telephone network to a host computer so that the telephone set can be operated as an interactive computer terminal.

An instruction is given to the host computer by inputting various conditions (the date of boarding, from where to where, the number of persons, etc.) to make seat reservation.
This service is also provided widely in Japan by railroad companies, airline companies, and various mail-order firms.

Japanese major railroad companies and airline companies have installed the voice response equipment in cities where host computers are located for seat reservation control.

A sufficient number of voice response equipment are installed throughout packet networks within Japan so that the assessment of larger access charges to remote area users can be avoided. Thus, the seat reservation service will reduce the labor of users, with the aid of host computers provided for seat reservation control.
An example of typical system configuration for this service is shown in Figure 2.

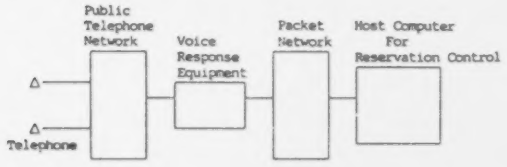

Figure 2 SYSTEM CONFIGURATION FOR SEAT RESERVATION SERVICE

4.3 INFORMATION PROVIDING SYSTEM USING MULTIMEDIA

"Dial Q" service (may be one of the "900s" services in Japanese version) will provide various types of services; most of them are services for providing various voice information recorded in the audio database equipment on a charge basis.

That is, the service providers operate their business by recording user information in the audio database equipment attached to public telephone networks, while allowing users to utilize their own audio database equipment for recording the user's information to be provided.

Recently, a multimedia-type information providing service has become available in Japan, which provides not only voice information, but also video information with the aid of a facsimile database equipment.

Figure 3 shows a system configuration for multimedia-type information providing service using a facsimile database equipment.

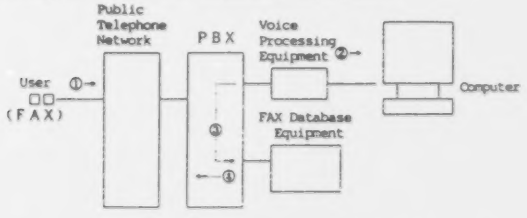

Figure 3 SYSTEM CONFIGURATION FOR MULTIMEDIA-TYPE INFORMATION PROVIDING SERVICE

(1) The user makes an access to the system by telephone.

(2) Required information is selected according to push-button signal.

(3) The voice processing equipment will transfer the information to FAX database equipment by making use of PBX extension line transfer function.

(4) FAX information in the FAX database equipment is sent out.

5. TELEPHONE NETWORKS - WHAT IT SHOULD BE IN THE FUTURE?

Telephone was invented by Graham Bell about 100 years ago and the times of manual switching system continued for some time since then. With the emergence of automatic switching system, so-called the information-oriented society has been drastically matured as is seen today.

On the other hand, however, the authors are of the opinion that the sophistication of modern communications has brought about dehumanization or a lack of human nature. We call a name of the other party in our conversation or in our letters.
Although a call was set up by calling names of a calling party and a called party during the period of manual switching, the automatic switching system sets up a call using emotionless and inorganic numbers, irrespective of our liking.

The authors feel as if we are in the midst of Charlie Chaplin's Modern Times, in a sense, satirizing the fact the human being was dominated by machine.
However, the authors consider that the dehumanization can be recovered to a remarkable extent by introducing the preceding voice processing equipment into existing communications infrastracture, along with the on-going development of technologies.

- "Personal" addressing in voice recognition technology:
  Implementation of communications approach by addressing names of calling and called parties, not by using inorganic numbers.

- Effective use of audio database equipment:
  Implementation of automatic message recording service when the called party is busy or absent to eliminate a bother to reattempt a call.

- Incorporation of multimedia:
  Implementation of optional services in which the user can select a preferred terminal device so that the user is not bound to use any device determined by machine.

Although these services are often provided by secretaries in most business firms, general public will also be privileged to receive even services after the implementation of

new communications infrastructure. Again, the authors wish to stress on that existing telephone networks should be eventually oriented towards the recovery from dehumanization with the help of further technological development, with the result that the user would feel a sort of the warmth out of humanized communications infrastructure.

6. CLOSING REMARK

NEC is making every effort in the research and development in various fields, including voice recognition technology, single-sound synthesis technology, and information management technology, to keep abreast with the advancing information-oriented society.

A PRIMER ON TELECOMMUNICATIONS STRATEGIES FOR THE DELIVERY OF DISTANCE LEARNING

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ABSTRACT

A continuum of delivery strategies for distance learning is developed to provide an historical perspective on present and emerging developments in telecommunications delivery of training and learning programs. Strategies from early face-to-face, print-serviced modes to present-day compressed video conferencing and future multimedia modes are reviewed from an introductory standpoint.

Introduction

Technologies for the delivery of learning are not novel, although one is left with that impression considering the pace at which telecommunications technology is developing. An unprecedented number of strategies for delivery of learning to the distance student are available to today's educators. The scope, diversity, and rate of change make selection of appropriate delivery mechanisms difficult and risky. Yet these decisions must be made and a stake driven if education and training are to remain abreast of the need.

A significant segment of change is occurring in video technology. The "video revolution", now of landslide proportions and gaining momentum, is due largely to advances in delivery technology. Television has been the mass medium of choice for over four decades, providing powerful life-shaping messages in areas of entertainment, news, and lifestyle. Video coupled with the computer and delivered via new digital technologies is putting the learner and the instructional developer in the "digital driver's seat". The union of computer and television with the new technologies of digital storage and delivery produce a technology called "multimedia". This technology gives added substance to the concept of television as a "universal medium" which has prevailed for forty years. Compressed digital video (CDV) is the glue which ties together diverse technologies by providing exceptionally cost-effective communication when bandwidth hungry analog transmission is reduced to narrow bandwidth by digital transmission. A dramatic illustration is the 6000 to 1 compression which occurs when a video image for a freeze-frame videophone is compressed from a full motion transmission rate of 90 megabits per second (Mbps) to 19.2 kilobits per second, allowing transmission on standard telephone lines (90,000,000 bps to 19,200 bps).

In its time the book was as novel and revolutionary as today's advanced multimedia delivery systems and held no less promise. Increased communication and interaction between the teacher and the student has been a driving force underlying development of every technology supporting the goal of learning at a distance. Existing delivery technologies have enjoyed varying levels of success in addressing the needs of the distance learner. Emerging technologies, particularly those involving a telecommunications component, have the potential to catapult distance learning to the forefront of the educational process. The client pool for non-traditional delivery of learning far exceeds the number of students now enrolled in traditional institution-based programs. These new technologies hold much promise as a means to attack the enormous task of education, training, and retraining facing the world as we hurtle through the few years remaining before being thrust into the twenty-first century.

The see-saw of the information and technology explosions throughout the nineteenth century has alternately created the need for and solution to the scope and level of education and training required to support the society of the time. To establish a perspective on telecommunications strategies for delivering distance learning, one must have a feeling for that which has gone before. The history of bringing learning to the student is a fascinating and integral part of present day advances in telecommunications delivery. The goal of this paper is to trace the evolution of distance learning delivery modes from the earliest person-to-person, local educational extension programming to present day telecommunications developments with global capability.

Distance learning is defined as a process of instruction characterized by separation of the

learner from the source of the instruction. In this process learning is facilitated by providing the learner with links to the originating site for transfer of information and for interaction with the teacher. The quality and capacity of links to the learner have enjoyed a constant state of growth, from the first correspondence courses in the late 1800s dependent on the mail service for interaction, to present day full motion interactive television instruction via satellite. Interaction with the remote learner has moved from sporadic, impersonal, delayed communication to real-time personalized dialogue with the instructor. More than a century of development has improved communication modes linking the learner with the originating site. New modes have not directly replaced the old but have consistently added another dimension. The importance of print and mail service to distance learning remains high, and new telecommunications technologies have improved access and interaction.

Strategies for delivery of distance learning by telecommunications cannot be considered in isolation from the preceding modes of delivery. Present day distance learning practice is a continuum from print to multimedia and mail service to satellite service. New strategies for delivery and interaction will not instantly replace serviceable existing modes. Rather, the old and the new must form an amalgam providing the best possible situation for the distance learner. Therefore, in the zeal to adopt the new, one must never lose sight of past and present methods. The increment results when the new is integrated with the old to take full advantage of the added telecommunications dimension. Cost effectiveness is a factor of distance learning that is best served by evolution rather than by revolution.

Until the mid-1800s word of mouth was the predominant mode for distance learning, and the instructor physically attended the instructional site. This mode remains predominant in many parts of the world today. Once print became established in the form of books, manuals, and newspapers, instruction at a distance was enhanced by learner access to a multitude of print-based information. Paper-based print formed the backbone of instruction at a distance for the past century and will remain a major information carrier well into the next century.

Delivery Continuum

History of distance learning delivery modes and devices of delivery in roughly chronological order would include: face - to- face - print - mail service - telephone - radio - audio tape - broadcast television - video tape - audio teleconferencing - cable television - videotex - telewriter - computer assisted learning - audiographics - computer conferencing - satellite delivery - facsimile - video conferencing - video disc - CD-ROM - business television - compressed video - multimedia. Figure 1 provides a graphic representation of the delivery continuum.

Passive/Interactive Modes

Media devices used to deliver the information component for distance learning fall into two basic configurations: passive devices (one-way), which do not provide interaction with the instructor, and interactive devices (two-way) that permit direct interaction. Interaction and feedback are judged to be essential components of the learning process for all except the literate, mature, and motivated learner. Telecommunications devices used in "teleconferencing" mode are part of an "interactive technology" linking learners, often in multiple locations, by two-way communication. Whether as an inherent component of an "interactive" device or as an adjunct to a "passive" device, telecommunications can make the difference for the independent learner. Figures 2 and 3 illustrate some of the passive and interactive media.

Research points out that learning supported by the emerging interactive technologies is equally as effective as traditional methods. A beneficial aspect of new technologies for delivery of learning is the capacity of the new digital technologies for elimination of the "batch" aspect of traditional and distant learning by allowing the learner to interact on an "asynchronous" basis (not in real-time but at a convenient time) with the teacher and/or with the content base. Telecommunications strategies for reaching and interacting with the learner demonstrate potential for establishing the 90s as a "decade of the independent learner".

Face-to-Face: This is the longest standing distance learning mode, with instructor and instructional materials travelling from the institution to the learner. Attempts are made to re-create institutional settings at the learning site. This mode, usually not cost-effective, is characterized by a high degree of interaction and low availability of resources. Instructors travel varying distances, in varying conditions, and by almost every conveyance imaginable, as illustrated by Figure 4.

Print: Gutenberg's invention of the printed page enabled the distance learner. Correspondence courses, books, manuals, periodicals, and newspapers remain today as a major mode for distance learning. The book allows the learner true independence, with access any time, anywhere, and in any sequence. Print is cost-effective and rich in digital and iconic information. A vast organized body of print resources exist. To be successful, print, as a

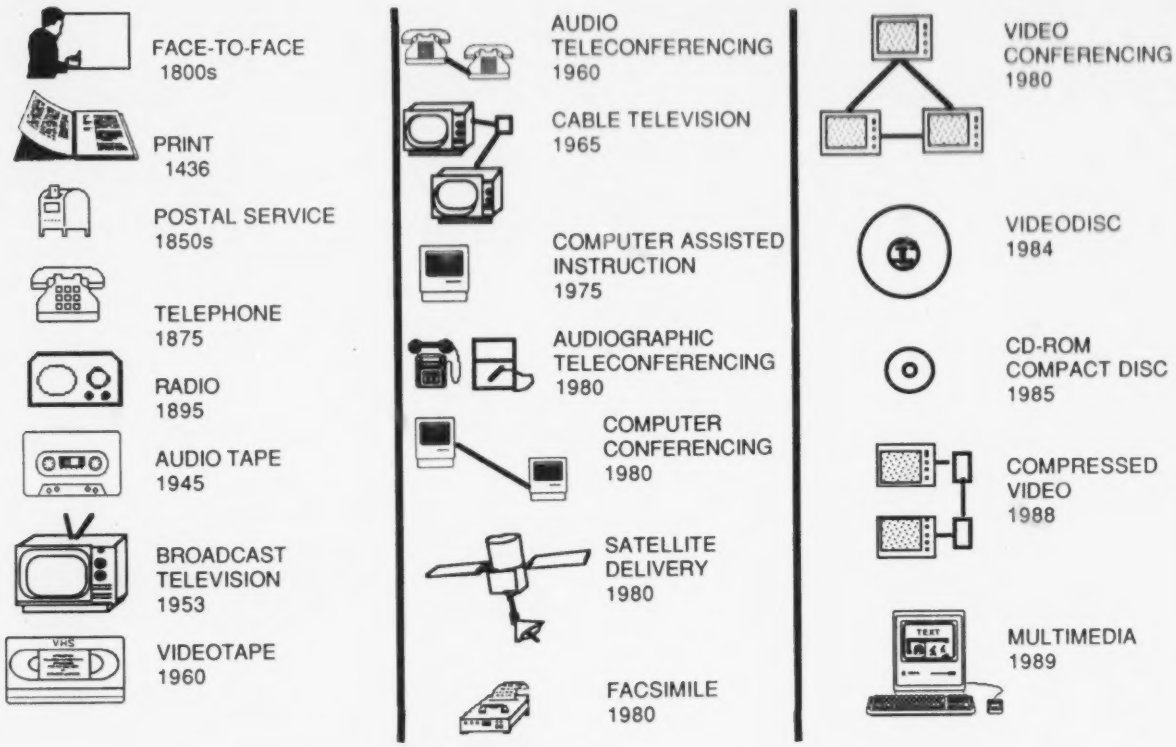

Figure 1
A perspective on delivery modes for distance learning arranged in chronological order.

Figure 2
Passive devices for delivery of programming to distance learners.

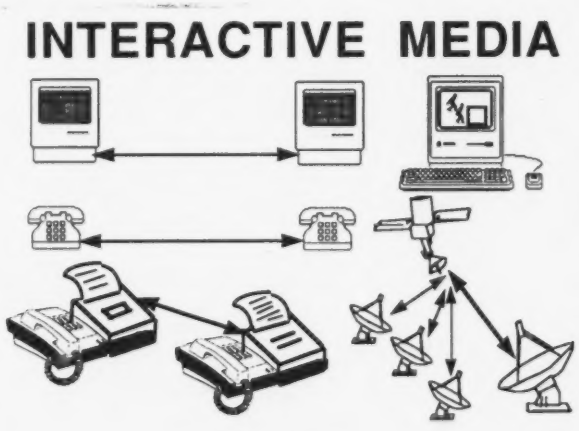

Figure 3
Interactive devices for delivery of programming to distance learners.

distance learning mode, relies upon a motivated learner with a basic level of literacy. It is cost-effective for small or large client pools, but instructional effectiveness my be reduced due to low or delayed feedback to the learner. Figure 5 outlines the various configurations associated with print and the usual forms of interaction.

Postal Service: A developed and reliable mail service continues to provide feedback as an interactive link between the learner and the instructional site. Interaction is delayed (asynchronous) and often cumbersome and inadequate. In situations where the remote learner does not have access to telecommunications the postal service is often

the only interactive link with the instructor. One-way instruction delivered by broadcast or satellite television often relies on the mail to provide interaction with the student. Mail service may provide both delivery of instructional materials and interaction with the student when learning is based on audio tape, video tape, or computer disc. Postal service is one of the most cost effective methods to deliver resources to the learner and receive feedback from the learner. Quality, consistency, and cost of interaction by mail depend upon resources available at the originating site.

Telephone: Bell's invention of the telephone made possible the first real-time (synchronous) interaction between the teacher and the distance learner. The telephone is truly a ubiquitous telecommunications device, a universal network in which one has a reasonable expectation that anywhere one calls in the world the telephone will be answered. Initially the telephone network was used to make it possible for remote learners to call the instructor and receive individual help with instructional problems. Audio teleconferencing, using a conference bridge, enabled many individuals to be networked in real time for instruction and business meetings. Some forms of video teleconferencing make use of the telephone network to transmit interactive video and audio for instruction and business applications. Recent innovations in video compression assure that the telephone network will remain a viable option for delivery of interactive learning. Digital technology and fiber optic transmission inject new potential into the telephone network

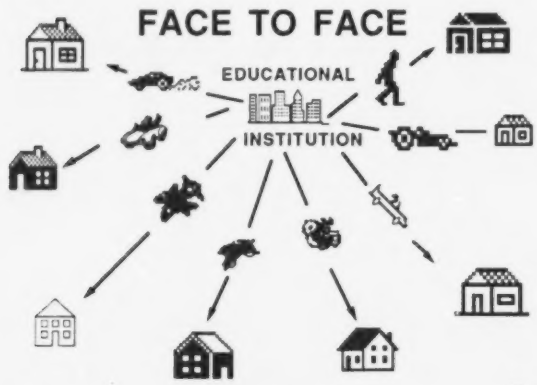

Figure 4
Face-to-face mode of delivery was the only channel available to early distance educators.

as a component of future distance learning and communications systems. The telephone network provides high interaction at low cost, and is effective for sparse, widely separated learner populations.

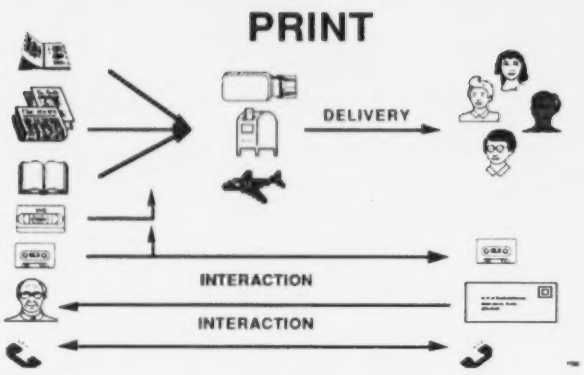

Figure 5
Invention of the printing press made it possible for widespread independent learning.

Radio: Marconi's invention of wireless communication enabled educators to provide learning to remote learners not reached by telephone and the postal service. For a number of years, schools of the air and school radio broadcasts provided learners with direct instruction and instructional enrichment. One-way audio instruction was cost-effective in that large numbers were reached, receiver cost was within reach of everyone, and cost of production was relatively low. It required an infrastructure to provide feedback and print related support materials and was instructionally effective when all components were in place because it provided motivation for the independent learner and did not require the same degree of literacy as print modes.

Audio Tape: Audio tape, particularly in cassette format, has enjoyed a long association with the distance learner as a medium of instruction and as an integral component of distance education courses. It is an effective learning medium due to portability, ease of review, potential for personalization, large body of readily available material, rapid low cost production of new material, inexpensive replay/record machines, and low cost of cassette tapes.

Broadcast Television: Broadcast television, in off-air mode, was the first medium to bring cost-effective, information rich, aural and visual information into the home. A visual channel greatly expanded the quality of communication beyond that which had been associated with telephone and radio as a delivery mode for distance learning applications Television earned the reputation of being a "universal medium" incorporating beneficial aspects of other media and is often described as "reality thirty times a second". The major drawback to broadcast television as an ideal medium for instruction was its passive one-way transmission

which relied on other media such as telephone or mail for interaction. Second, third, and fourth generation developments in television (cable, satellite, and multimedia) have overcome this limitation. Television has maintained its position as a "universal" medium by being incorporated into the multitude of modes now delivering programming for distance learning. The information rich audiovisual nature of television enhances its ability to transfer knowledge and abstractions to learners who possess minimum levels of visual and print literacy. Cost of production, inflexible schedules, lead time, technical expertise, security, and production expertise limit use of broadcast mode television as a distance learning medium. Later developments in television have eliminated some impediments, but cost and requirement for quality of production continue to limit its widespread use in distance learning. Figure 6 shows the possibilities for broadcast, cable, and satellite distribution of distance learning materials.

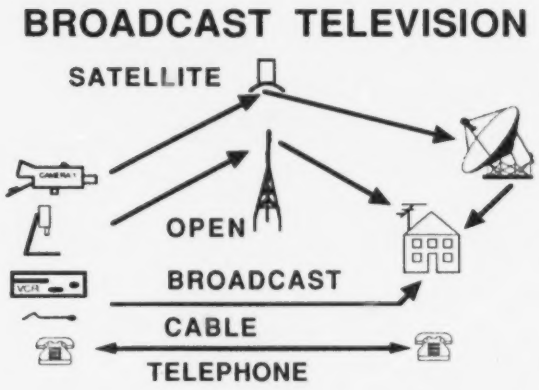

Figure 6
Broadcast, cable, and satellite television deliver full motion, color, high quality television for education and training.

Video Tape: This medium possesses the beneficial qualities of broadcast television and eliminates some of the disadvantages. Video tape is a flexible medium because the learner can use it at any time, it integrates easily with other media, has a large program capacity, low cost recording medium, and low cost replay equipment.

Audio Teleconferencing: This refers to use of the telephone on the Public Switched Telephone Network (PSTN) to enable three or more people in two or more locations to share a common discussion. The simplest teleconference uses a speaker-phone at each of two locations, enabling individuals at both locations to carry on a discussion with each other. When a telephone bridge is used a discussion between three or more telephones can be carried out simultaneously. The modern electronic telephone conference bridge permits automatic dialing of all conference participants, allows individuals to call into the conference, announces conference participants, and monitors and adjusts volume and quality of the telephone links. New digital telephone exchanges permit subscribers to link up or self-convene from two to six participants in a conference mode. Standard telephone bridges accommodate up to thirty conference connections, and in special cases thousands have been accommodated in one conference. Figure 7 illustrates two configurations for audio teleconferencing.

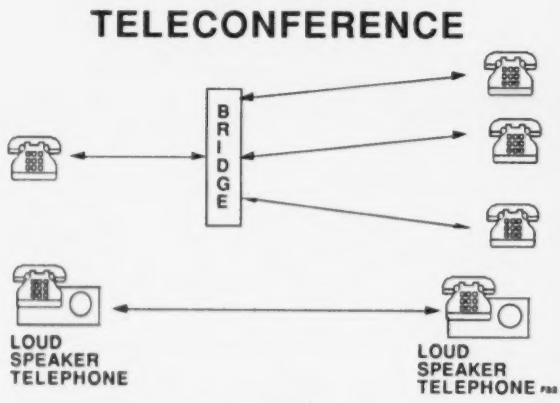

Figure 7
Audio teleconference is one of the earliest interactive modes of delivery of learning to the isolated or remote student.

Cable Television: Transmission of video is through coaxial cable or optical fiber directly from source to subscriber's television set. Several signals (channels) may be transmitted at the same time and selected by the tuner on the television receiver. It is possible to transmit signals in both directions to permit subscriber interaction. It requires very little power in comparison to off-air broadcast television and is cost-effective in densely populated areas. Most public cable operators are required by legislation to provide a dedicated education channel. Creation of programming is subject to the same cost/quality constraints as broadcast television. Channels available in VHF (2-13) and UHF (14-83) provide broad possibilities for scheduling, but cable operators tend to fill low channels with prime time revenue producing programming and relegate educational programming to unsocial times or to less accessible high UHF channels. In populated areas cable television has great potential for distance learning because it constitutes the Second Universal Network appearing in a large

percentage of the homes. Integrated with the telephone network for feedback and interaction further enhances cable as a mode to deliver effective distance learning programming to a broad spectrum of the population. See Figure 6.

Visual Electronic Remote Blackboard (VERB): This involves transmission of voice and textual material from instructor to student using regular telephone lines. The instructor's voice, as well as material created by the instructor with a stylus and drawing pad, is transmitted to the instruction site. Voice is reproduced at the distant site on a loudspeaker, and the textual material is reproduced by a stylus on the stage of an overhead projector. Second and third generation VERB systems capitalize on advanced technology to reproduce the image on white boards, computer screens, and in color modes. Hard copy of black or white board images is an option on newer systems. VERB has been superseded by audiographic conferencing which involves interface of voice and computer images over regular telephone lines.

Teletex: This is the generic name for a set of systems transmitting alphanumeric and simple graphic information via the extra line capacity in the vertical interval of the television picture. Broadcast and cable television systems transmit textual and graphic information during regular programming. Teletex information is decoded and displayed on a modified television receiver. At one time teletex held great potential for education, but technological advances in transfer of data curtailed much of the development work in this medium.

Telewriter: Microcomputers are linked through the telephone network to send and receive textual and graphic material. Data may be input from the keyboard of the microcomputer or by writing or drawing on a digitizing tablet. Information is viewed on all computer screens at the same time and may be converted to hard copy at any site. This mode is a synchronous mode of computer conferencing. Telewriter technology, as used to enhance audio teleconferencing, has developed into the mode known as audiographic teleconferencing.

Computer Assisted Instruction (CAI): Students interact directly with instructional material programmed into the computer system.
Computer Managed Instruction (CMI) The computer system is used to manage information on student performance, progress, and resources in order to prescribe, guide, and administer the instructional process to maximize learning efficiency. CAI and CMI may be carried out via telecommunication links by use of a modem on switched networks. CAI may function effectively by using the mail service to deliver discs to the learner. CAI emulates student/teacher interaction, provides immediate feedback, allows student to control pace and time of learning. CAI is an asynchronous mode of computer conferencing in which the student interacts with the host computer rather than with other computer users in the network. Instructor/student interaction on an asynchronous basis with the host computer establishes a feedback link and enhances the effectiveness of this form of instruction.

Audiographic Teleconferencing: Teachers and learners are connected via a combination of voice and computer, using narrow band telecommunications channels to transmit alpha numeric data, graphics, and freeze-frame video images. A telephone bridge connects students and teacher together in audio teleconference mode, and by using special software, students' computers are connected by modem to the teacher's computer. Information created on the teacher's computer, graphics tablet, frame store, or digitizer appears on each of the students' computer screens. The computer screen provides each participant the equivalent of an electronic blackboard. In older systems two telephone lines were required for carrying voice and computer data. In newer audiographic teleconference systems both voice and computer data can be transmitted on one line, resulting in much reduced carrier cost. See Figure 8.

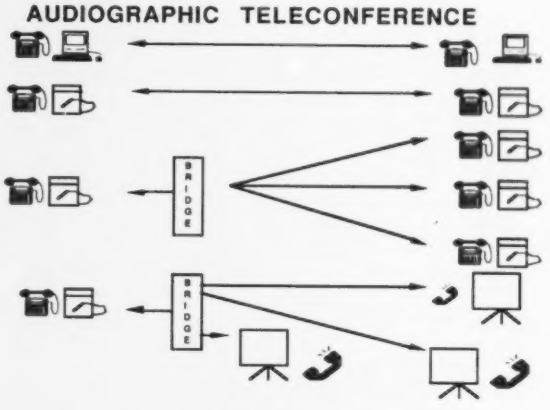

Figure 8
Audiographic teleconverencing adds the dimension of text, graphics and computer screens to standard audio teleconferencing.

Computer Conferencing: Two or more computers are connected using modems and narrow band telecommunication channels. Communication may be in synchronous mode to connect instructor and student in real time and emulate face-to face instruction, or it may be in asynchronous mode which uses a host computer

to store information for later access, such as electronic mail or bulletin board. When more than two computers are linked a data bridge is required. See Figure 9.

Satellite Delivery: A satellite located in geostationary orbit appears to earth stations as fixed in space and provides a broad "footprint"

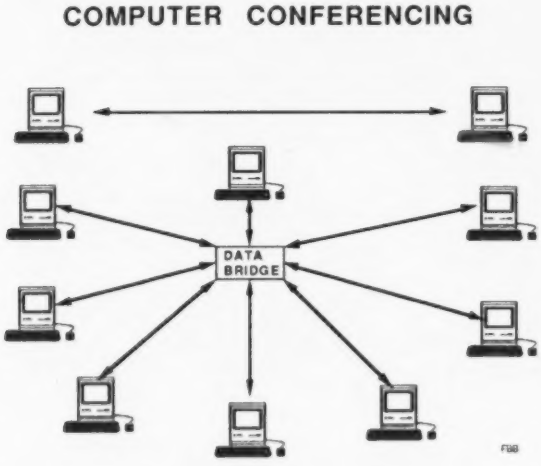

Figure 9
Computer conferencing enables the learner to interact with content and with the instructor in real time or at a convenient time.

from which it can receive transmissions from an "uplink" and re-transmit to any number of "downlinks" within the area of the footprint. This type of signal distribution is called point to multipoint. Each satellite has up to 40 receive/transmit transponders capable of distributing audio, video, and data signals. A number of satellites spaced in orbit can form a network capable of transmitting and receiving information to and from any point on earth. Satellite distribution can serve remote areas not linked by other telecommunication services. Satellites are most effective when used over a large geographic area with a large number of participants in local, national and international networks. Capable of bi-directional communication, satellite transmission of distance learning material is more often one-way with learner interaction provided by telephone link. Cost, programming constraints, terminal equipment, and lead time have restrained the small user. However, data compression, spectrum division, and advances in digital technology are reversing this trend to some extent. VSAT (very small aperture terminals) provide cost-effective bi-directional satellite delivery of narrow band programming of voice and data and are used extensively by corporations to link widespread offices. VSATs are an economical way to create a private network for business television (BTV). Educators make use of satellites operating at two different frequency allocations called C-band and Ku-band. C-band satellites were the first commercial carriers providing service to television and cable networks. They operate in the 6/4 KHz range and require relatively large receive dishes. The Ku-band satellites are more powerful, operate in the 14/12 KHz range, and, as they are more powerful, require smaller receiving dishes. See Figure 6.

Facsimile (FAX): This is a device and process consisting of a scanner to convert hard copy to an electronic signal which is then sent by modem on a standard telephone line to the receiving site where the signal is decoded, reassembled, and printed. Facsimile transmission has been possible since the 1920s. It was not until the mid 80s that the high-tech digital FAX made it possible to send facsimile images in seconds rather than minutes, and the cost of machine and carrier dropped to a point where FAX is now a universal component of every office. Although facsimile can been used as the sole mode for distance learning, it is most commonly used to provide hard copy interaction between learner and teacher as an enhancement to other distance learning modes. Developments in FAX transmission permit the FAX signal to be embedded in video for simultaneous delivery, during a videoconference, of hard copy such as evaluation and course materials.

Video Conferencing: Sites are linked by a video picture and voice using a telecommunications channel suited to the type of video required. Video conferencing can be carried out in three basic modes: freeze frame, compressed, and full-motion video, spanning bandwidths from narrow to wide. Point-to-point or multipoint conferences are possible and employ two-way video/two-way audio or one-way video/two-way audio interaction between sites. Any graphics or other material that can be picked up by a television camera can be displayed at all sites, and textual or graphic material may be annotated by presenters. Video conferencing emulates a face-to-face meeting and has the advantage of social presence which enhances the richness of information communicated. Digital technology using compressed or compensated video on the public switched telephone network (PSTN) has revolutionized the ease by which organizations can participate in cost-effective, fully interactive, real-time conferencing on a network basis. Business, industry, government, and education have adopted this format in a massive move to establish full-function, interactive communication for training and distance learning.

Compressed video teleconferencing has become very popular because of significant savings in

transmission costs and improved access, since the standard telephone network is used. Figure 10 shows the configuration for point-to-point and multipoint video conferencing using compressed video. Figure 11 illustrates the bandwidth choices available to conference users by comparing the number of standard lines equivalent to various compression rates.

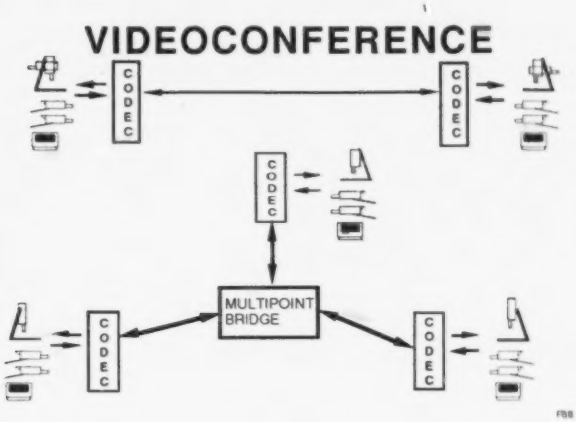

Figure 10

Video conferencing is the fastest growing form of corporate and educational communication providing full function interactivity between student and teacher.

Videodisc: This is a plastic disc approximately 30 cm in size which is encoded by digital laser technology with up to 54,000 still images or 30 minutes of full motion video. Motion and still images may be combined on the same disc. Random access to images may be controlled by: instructions recorded on the disc itself, instructions programmed into the disc player, input to the player by bar code, or computer programs. Video disc is becoming one of the main sources of program material for multimedia applications. Coupled with a computer the video disc becomes a powerful learning device with good image handling, interactivity, image, and audio quality. The major drawback is the cost of original videodisc production and cost of interface equipment. Once produced, videodisc duplication cost is minimal and images are not degraded by use.

CD-ROM: (Compact disc read only memory): Plastic discs 12 cm in size are encoded by digital laser technology providing on-line computer access to a vast amount of audio and video information. A single CD-ROM disc can provide the learner with on-line access to huge data bases such as encyclopedia and research documents. This device is a key element in multimedia learning systems. It is cost effective for large stable data bases since this mass storage device is read only and requires complete re-manufacture to include new or updated information.

Business Television (BTV): This includes training, informational, and educational television production and programming to private or closed group audiences. In the past it was generally carried by satellite with telephone interaction. Recent developments in compressed or compensated video have opened up this mode of broadcast for BTV via digital lines on the public switched telephone network. BTV provides business and industry with a cost-effective way to disseminate information and training to multiple, distant sites without incurring high personnel, travel and time costs associated with on-site meetings. Major advantages are that live, interactive communication can be carried out, ensuring that all employees at all levels receive the same information at the same time. Business television users often establish their own network or participate in the increasing number of narrowcast networks established to provide service to a specific users with common goals, such as automotive dealers, financial consultants, or workers in penal institutions. These new networks tend to be industry-wide, cutting across corporate and product boundaries.

Compressed Video: The analog television signal as it is produced requires a tremendous amount of bandwidth to transmit (about 90 Mbps) when the waveform is combined with synchronization data and modulated unto a carrier signal for transmission. Digital technology permits encoding of the analog television signal in a much more efficient manner for transmission. Compressed digital video (CDV) reduces the amount of redundant information transmitted, and motion compensation results in only the changes between frames being transmitted. Compression rates can be as high as 6000 to 1 for freeze frame video at 19.2 Kbps to 60 to 1 for motion video at 1.5 Mbps. Compression is accomplished by a Codec (coder-decoder) which processes and encodes the analog audio and video television signal for transmission; once transmitted, a similar unit reverses the process by decoding the digital signal, returning it to analog which can be viewed on a standard receiver. See Figures 10 and 11.

Compressed video is expanding video teleconferencing in two major areas -- training and distance education. In satellite broadcasting, compression permits up to 20 channels to share one satellite transponder. Formerly one transponder was required to transmit wide band analog television signals. Compressed video reduces the bandwidth of television signals to the extent that terrestrial lines become practical. Digital transmission can be carried on standard public telephone

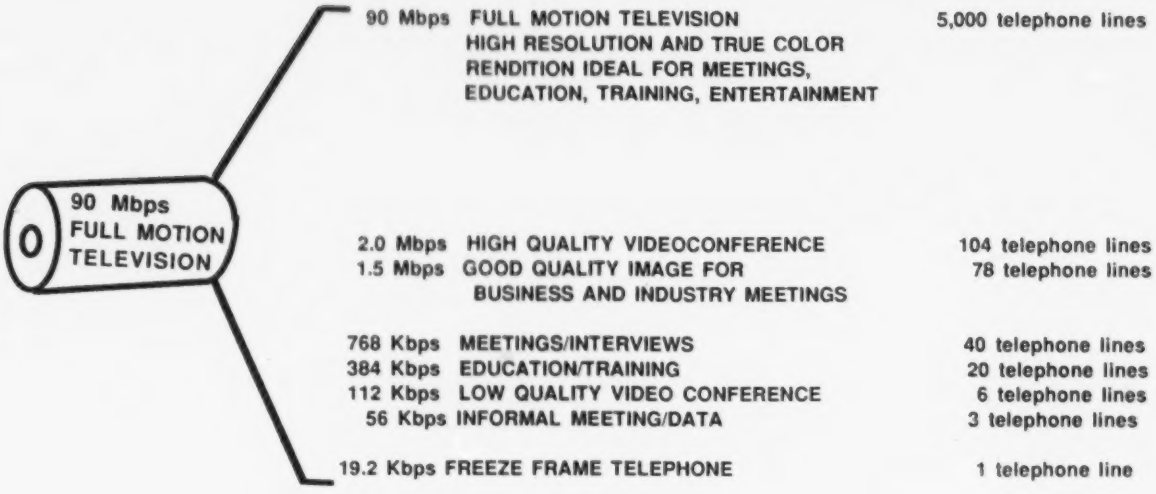
90 Mbps FULL MOTION TELEVISION
90 Mbps FULL MOTION TELEVISION HIGH RESOLUTION AND TRUE COLOR RENDITION IDEAL FOR MEETINGS, EDUCATION, TRAINING, ENTERTAINMENT
5,000 telephone lines
2.0 Mbps HIGH QUALITY VIDEOCONFERENCE
104 telephone lines
1.5 Mbps GOOD QUALITY IMAGE FOR BUSINESS AND INDUSTRY MEETINGS
78 telephone lines
768 Kbps MEETINGS/INTERVIEWS
40 telephone lines
384 Kbps EDUCATION/TRAINING
20 telephone lines
112 Kbps LOW QUALITY VIDEO CONFERENCE
6 telephone lines
56 Kbps INFORMAL MEETING/DATA
3 telephone lines
19.2 Kbps FREEZE FRAME TELEPHONE
1 telephone line

Figure 11
New digital technologies are providing access to more channels of communication by using bandwidth in a more efficient manner.

switched network lines on a bandwidth-on-demand basis using multi-band inverse multiplexers to provide the bandwidth needed for the quality of transmission required. The user pays only for the bandwidth selected and the time connected. See Figure 12.

Manufacturers are introducing new lines of videoconferencing equipment of multi-mode design which have ushered in a new era of "application-driven" video conferencing. New codecs, inverse multiplexers, and vision processors coupled with improved compression algorithms and digital dial-up data lines are changing the face of teleconferencing. The user can establish enormous cost savings by eliminating high-cost dedicated data lines of specific capacity for equipment that will access the required bandwidth on demand from the telephone switched network. Savings are further compounded when the user can select the bandwidth and compression for a specific application. In general the larger and more formal the group activity the greater the requirement for picture quality.

Videoconferencing has aspired to provide "in-the-same-room" quality of picture and interaction between remote sites. Full motion video, CD quality audio, and full two-way audio/video transmitted over fiber optic channels have indeed reached this plateau. Cost and installation lag prohibit wide-scale application of this vision for videoconferencing to all but selected geographic sectors. New compression technology and the effectiveness of compressed and compensated video for specific applications are helping to establish links with independent, geographically separated learners.

Multimedia: Each technology of communication as it has evolved and matured has exhibited unique qualities and capabilities useful in support of learning oriented opportunities.

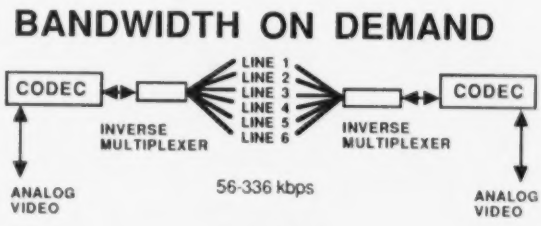

Figure 12
Digital video compression is making it possible to use the public telephone network to access the amount of bandwidth required while paying only for the time connected.

Multimedia is characterized by the convergence of these separate technologies into a whole that is far superior to the individual components. The cement of this union is the multimedia software which brings together computers, television, print, telecommunication, and mass information storage devices into a unified system. Multimedia systems not only exploit the beneficial qualities of each assimilated technology but provide a high degree of interactivity between the learner, developer, teacher, and learning materials. Multimedia will have tremendous impact on the way educators do business in the future. Educators and

learners will have a high degree of decision making in the design, development, and use of the learning experiences provided. One might say that both the instructor and the learner will be in the "digital driver's seat" in all aspects of the development of learning experiences and the later use of these experiences. Multimedia has been referred to as "digital fusion", representing the bringing together of digital technologies by the unifying power of the computer.

Multimedia is in its infancy; yet, as we approach the millennium, it is having significant impact on education and training. The operating paradigm today makes use of the "windowing" capability of computer software to inset and overlay information in any order and from a multiplicity of sources including computer disc, CD-ROM, video tape, audio tape, laser video disc. Multimedia software enables the instructor to organize information using the capability of the computer to program and manage information and provide a tailored learning experience for learners of all types, levels, and capacities. On the learner side multimedia enables the learner to plan, execute, and manage his or her learning experience at the rate, place, and time of the learner's choice. New digital storage, compression, and delivery technologies will, as they come on stream, provide ever increasing access to information bases and to live teacher/peer interaction. See Figure 13.

Conclusion:

Strategies for delivery of distance learning are in a state of flux and will remain so for most of the remaining years of this century. Educators cannot afford to wait for a stable platform from which to safely take the initiative to provide learning where it is needed. The best any of us can hope for is to make the necessary decisions from as solid a knowledge base as possible. This "primer" discussion has, on an introductory basis, placed past, present, and emerging technologies in perspective. The overview took a cursory glance at various technologies available to the user. Change is happening at a pace which finds new developments in use before periodical literature and even manufacturer's data sheets are updated. This pace is illustrated by the continuum of devices and processes arranged in approximately chronological order in Figure 1. It is of some comfort to note that most of the processes for delivering distance learning are still in viable use today. We must also consider how the space between innovations is closing up. Multimedia, which assimilates most former communications modes using the power of organization found in computer software, allows us to view the future with a great deal of optimism. Using this new learning system configuration is some guarantee that little of what we have done before will be a loss. Multimedia and new telecommunications technology ensure that today's distant students will have a place and a time to learn.

Figure 13
Multimedia is the converging of existing communication technologies by harnessing the power of the computer to access and manage information derived from almost any source..

THE GLOBAL CLASSROOM: A TELECOMMUNICATIONS EVENT FOR EDUCATORS

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1. ABSTRACT

The paper focuses on an event that linked students and educators at multiple locations from Texas to New Caledonia. Technology at the various sites differed and the event showed how the existing technologies could be integrated to bring all parties together to learn about volcanoes, an issue of great importance to the Pacific area. This project is offered as a model for others to use in order to hold similar low-cost, cooperative, multimedia events for educational telecommunication purposes.

2. INTRODUCTION

Technological advances give today's educators new tools to explore exciting horizons and link people all around the globe. However, technologies often differ at various locations wishing to communicate making those links difficult. One may then abandon the planned link. On April 24, 1991, a group of educators overcame that barrier and linked multiple classrooms from Texas to New Caledonia using very different technologies at these multiple sites. The resulting event spanned seven time zones and crossed the international date line.

3. BACKGROUND

The historical climate for this event began in the fall of 1990 when a member of Hawaii Science Teacher's Association (HaSTA) asked to have a workshop on using Distance Learning--Technology resources. That idea was shared with leaders of the University of Hawaii Manoa's (UHM) MultiMedia Inquiry Group; and in less than a year, that request resulted in this innovative, international demonstration of multimedia technologies made possible by the involvement and cooperation of several groups. The event was sponsored by UHM MultiMedia Inquiry Group, HaSTA and the Department of Education Distance Learning Technology Program (DOE-DLT) in cooperation with PanPacific Education and Communication Experiments by Satellite (PEACESAT), and the University of Hawaii's (UH) Office of Information Technology with the Hawaii Interactive Television System (HITS). These groups enabled us to plan the global classroom event which originated in Hilo and was received by faculty and students in Honolulu, American Samoa, New Caledonia and two locations in Texas. Each of these locations used different combinations of technologies to access the program. This paper will highlight the technologies, organizational processes, and outcomes of the event which took place in April, 1991. It will include the perspective of the presentor in Hilo as well as the reactions of three groups--those at the various receive sites, those directly involved in the delivery systems and those responsible for the logistical support of the event. This project is offered as a model for others to use in order to hold similar

low-cost, cooperative, multimedia events for educational telecommunication purposes.

4. GLOBAL CLASSROOM FORMAT AND SCOPE

The format of the event involved Dr. Carl Johnson, University of Hawaii Hilo (UHH), Professor of Geology, teaching a short unit on Volcanoes from a studio in Hilo, Hawaii, which was transmitted to learners in Denton, Texas; Sanger, Texas; Honolulu, Hawaii; Noumea, New Caledonia; and Pago Pago, American Samoa. The range of technologies used included full-scale video, videophones, FAX, audio-only phones and satellite communications. Each site used different combinations of technologies to follow Dr. Johnson's presentation. The program could be seen on several public access channels across the state of Hawaii reaching many homes and schools. The volcanoes presentation was 20 minutes in length followed by a presentation on the various technologies being used and ended with a question and answer session which included a chance for all sites to comment on the strengths and weaknesses of the technology at their site. The moderator, located in Honolulu, orchestrated a roll call of participants with introductions and coordinated the question/answer/comment part of the hour.

4.1 PRESENTOR'S PERSPECTIVE - HILO SITE

(GMT April 25, 0100-0200 = April 24, 3:00-4:00 PM HST) (full-scale video, phone, videophone, videocamera input into videophone)

Although the experience described here emphasizes the technical aspects of distance learning, the choice of teaching material is itself critical. Many subjects of broad appeal are more effectively dealt with in a traditional venue such as the university classroom. Telecommunications becomes the method of choice when the target community is physically scattered and it is not practical to bring potential students together at a single learning center. This is most often the case with highly specialized material that is intensely interesting to a limited community.

The teaching unit chosen communicated information regarding a summer program of the UHH administered by the Center for the Study of Active Volcanoes. Each summer an intensive, experience-oriented, training program is offered to the staff of many of the world's volcanological observatories in monitoring and volcano hazard mitigation. The target community is thinly distributed worldwide at those places that have or anticipate having to deal with impending eruptive crises. In many cases, because of the exigencies of the hazard, personnel are not free to travel for periods long enough to acquire the necessary training skills. The teaching unit presented was a prototype of the introduction to this program, and the material was presented in a way that accommodated local access to technological resources. All of the remote centers were at least connected by audio communication links through PEACESAT via satellite and/or telephone. Many of the sites also possessed FAX and video telephone capabilities. Simultaneously material was being delivered within the state of Hawaii via HITS (Hawaii Interactive Television System). The nesting of these various technologies, concomitant with the interests each media served, caused us to consider our experiment to be something of a twentieth century allegory.

As the material was simultaneously addressed to diverse audiences, both educators as well as perspective students of volcano monitoring, numerous technical challenges were encountered during the actual presentation. It was necessary to respond at one level to inquiries coming in via interactive television while at the same time maintaining the content of material on volcano monitoring training over audio and videophones. During the presentation of the material in the teaching unit, the focus shifted from the television audience to the remote sites. One thing that became particularly clear during the telecommunications experience was the requirement for adequate support staffing at the point of origination. To be effective in delivering complex material of the sort for which remote learning is most appropriate, the teaching professional must be isolated as much as possible from the technical requirements needed to facilitate all of the communication links. This is something which will receive much more attention as we plan and carry out our next experiment in the delivery of technical material to remote audiences using rapidly evolving telecommnications technology.

4.2 AUDIENCE PERSPECTIVE - DENTON, TEXAS, SITE

(GMT April 25, 0100-0200 = April 24, 8:00-9:00 PM CDT) (phone, videophone, PEACESAT via ATS-3)

The day of the session had become night in Denton, Texas. It was the welcomed end of a 12-hour day for the Telecommunications and Informatics Laboratory at the Texas Center for Educational Technology. Goals for participation were simple: 1) provide technical support and backup communications (if needed) for the Sanger, Texas, site and its participants, and 2) demonstrate cost-effective telecommunications technologies to 6-8 University of North Texas College of Education graduate students who had expressed an interest in observing the session in order to augment their classroom experiences.

The Denton, Texas, site was a conference room with a videophone slow-scan television unit connected to the conferencing bridge at the University of Hawaii by way of a long distance telephone call. In an adjoining room, a PEACESAT ground station operator simultaneously monitored Dr. Johnson's presentation on the ATS-3 satellite and used a second phone line to maintain behind-the-scene voice contact with the Sanger site. A volunteer videotaped activities as observers occasionally circulated from the conference room into the adjoining control booth.

Observers were genuinely impressed with the performance of the combined technologies and the content of Dr. Johnson's talk. Even support staff became sufficiently interested to formulate questions for Dr. Johnson during the discussion portion. Observers were able to gain firsthand knowledge of how much is gained by adding slide-type illustrations, which were available through the videophone, to the voice-only mode delivered via ATS-3. Some also came to better understand concepts such as satellite turn-around delay, since the audio transmission from ATS-3 lagged behind the telephone connection by a few fractions of a second.

The exchange was judged by lab personnel as the best executed and most interesting of the approximately half dozen made available through the Telecommunications and Informatics Laboratory during the 1990-91 academic year. It is believed to have been the result of a clearly conceived purpose, carefully planned activities, and experienced support personnel at each site.

4.3 AUDIENCE PERSPECTIVE - SANGER, TEXAS, SITE
(GMT April 25, 0100-0200 = April 24, 8:00-9:00 PM CDT) (phone, videophone, PEACESAT via ATS-3)

Even though the session for Sanger, Texas, occured late at night, the teleconference was attended by a representative of the Department of Technology for the school district, the superintendent of schools, a computer literacy teacher, several students and two parents. The goals for the teleconference for Sanger might seem different from those of the University of North Texas and Hawaii, but in reality, they were simple: 1) demonstrate the accessibility of remote telecommunications for a small, rural, Texas school, 2) provide real-time, real-world, telecommunications activities for science teachers, computer teachers, students and 3) demonstrate to parents the value of telecommunications in the presentation of curriculum materials.

The Sanger site was much like that of the University of North Texas. A videophone was used for a direct land-line hookup; and, simultaneously, our PEACESAT ATS-3 ground station monitored Dr. Johnson's presentation. The session was taped for play back at a later time.

Members of the audience were impressed by the fact that Dr. Johnson's slides were sent via videophone for presentation to the Sanger site. Participants could see from the very beginning that science could be presented in a much more interesting format than that of just textbooks and filmstrips. Science became real and meaningful. Having an expert talking "real-time" to our students and participants was very impressive. The only drawback was that of time delay between the satellite and that of the videophone.

Even though Sanger has had other teleconferences, including some with people at the South Pole, this teleconference was extremely well received. It focused on the fact that "kids" learn by having hands-on, real-time activities. Having experts in their fields such as Dr. Johnson only added to the realization that students don't have to be passive listeners. They can now be active learners... knowledge users.

4.4 AUDIENCE PERSPECTIVE - NEW CALEDONIA SITE
(GMT April 25, 0100-0200 = April 25, 9:00-10:00 AM PST) (PEACESAT via GOES-3, PC, phone, FAX)

The PEACESAT communication system was recently installed in the South Pacific Commission (SPC) in Noumea, New Caledonia. As the system began to operate, it became an eye-opener to most of the members in this organization. The majority of the professionals in this program are used to other "normal" types of communication, such as telephone, FAX and electronic mail. The PEACESAT system offered something very special--it is very inexpensive to operate, provides facilities for telephone links, FAX coupling of computers to it and has the capability of use in conferences, meetings and for instructional purposes.

The presentation by Dr. Carl Johnson about the volcanoes emphasized the potential of this important tool/equipment for educational purposes for our 27 countries and territories of the South Pacific region. The pictures sent to other sites live via videophone were sent ahead by FAX to Noumea. Amongst the three people in the room (two educators and a scientist) the atmosphere was exciting and electrifying, that is to be able to participate in the discussions to learn more about the PEACESAT operation and its network around the Pacific rim. The quality of the reception in Noumea was excellent. For any regional dialogue or communications between all the SPC member countries, it will be excellent service to a lot of the tiny, remote atoll nations, where present communication is a big problem. If all the 27 island countries and territories were served with a PEACESAT station, education can reach children, the grassroots and others in these scattered and remote islands instantaneously.

The Noumea site did not have a TV monitor installed in order to see the other participants talking, however, this did not deter our enthusiasm in any way. As this new communication system was recently installed, it was an experience we will not forget. We look forward to learning more about this new technology and how it will assist the organizations and the Pacific Basin.

5. DISTANT EDUCATION DELIVERY SYSTEMS

5.1 OFFICE OF INFORMATION TECHNOLOGY - THE HITS PERSPECTIVE

While momentous in occasion, the Global Classroom demonstration was a coordinating challenge requiring extreme flexibility due to the geographic dispersion of the presenter and audience, the multiple telecommunication technologies, and the need for finding a time to practice with all. In retrospect, the critical component was the practice session, in conjunction with having identified program producer and content specialist.

A practice session is crucial for these types of programs due to the number of people, technologies and geographic distances covered. In this experience, there were many technical details that needed to be set up and tested--the Hawaii Interactive Television System (HITS), a two-way, video, interactive, television system connecting the Hawaiian islands; videophones; PEACESAT bridge; microphones for the speakers; and FAX machines. These sessions can help identify feedback problems, the flow of events, the setup of the room, placement of cameras and guest speakers and testing between two-way receive sites (UHH and UHM). In a dynamic experience such as this one, it was difficult to identify one program producer and one technical director since even until immediately prior to the program going on air, it continued to evolve; however, these roles should be clearly defined. Otherwise, the end result may appear fine but at a great toll to the support staff.

Since the practice session to test all these systems for the Global Classroom was not held, the support staff at UHH and UHM scrambled to accommodate the needs of the program. Many of the "bugs" had to be worked out while the program was in progress. The end result was a satisfactory program but proved the need for practice sessions which often get sacrificed because of heavy program scheduling. However, such time must not be neglected. This demonstration itself was very interesting and the process a challenging planning and coordination exercise. It was exciting to see multiple technologies being used to span the globe. It also taught us that planning, coordination, and practice are essential to a good program and even more so than in regular "in class" presentations.

5.2 THE PEACESAT PERSPECTIVE

For PEACESAT, 1991 represents a tremendous learning period for its distance education users throughout the Pacific; and the Global Classroom presentation experience was one more step in this learning process. Although PEACESAT has been actively contributing to the distance education experience in the Pacific for twenty years via ATS-1 and ATS-3, the recent reestablishment of a total Pacific footprint using GOES-3 with its advanced technological capability is allowing PEACESAT's educators to take great leaps in their technological mindset as to what can be done with telecommunication-assisted educational delivery. The combination of HITS, PEACESAT/GOES-3/ATS-3 and bridged telephone connections delivering education via interactive full-motion and freeze-frame video, facsimile, voice, and data was a mind-boggling reality to all PEACESAT participants of what the future may hold for distance education.

Two immediate and specific insights brought about by this telecommunication experiment for PEACESAT were: 1) the necessity of consistent use of multi-application distance education practices and, 2) the need for standardization of PEACESAT ground station sites in the technology that is currently possible. "Practice," as termed elsewhere in this paper, means something different to the PEACESAT users. Practice must involve real content or else the practice does not translate to users. It was also made very clear to PEACESAT Headquarters that all sites need videophone capability now that the GOES-3 technology supports its application, and this Global Classroom presentation provided the impetus for an across-the-board grant application for this technology.

Innovators in distance education delivery need to be encouraged to go beyond one-time events to regularly scheduled sessions, so that, by their example, others on the edge of the technology will be tempted into the realm of 21st century educational delivery systems.

6. LOGISTICAL/SUPPORT SYSTEMS

6.1 CENTER FOR TEACHING EXCELLENCE - CTE PERSPECTIVE

The Inquiry Group coordinator at the Center for Teaching Excellence (CTE) at UHM provides logistical support to events sponsored by the MultiMedia Inquiry Group and other faculty-led Inquiry Groups associated with CTE. The responsibilities were primarily to facilitate communication between the core group of event sponsors and to create promotional materials to be used in Hawaii. This involved coordinating the initial planning meetings and also setting up an e-mail "loop" among most of the core group. A flier was drafted publicizing the event and distributed to core group members for their comments. A camera-ready flier was then created and used to publicize the Global Classroom to educators in Hawaii. A one-page resource sheet listing distance-learning contact persons in Hawaii was developed and was available to Global Classroom participants on the day of the event. CTE distributed materials to the UHM community while the DOE-DLT program distributed the flier to teachers in the public school system in Hawaii.

Expenses incurred in publicizing the event consisted of about one day of staff time necessary to create the flier and resource sheet, duplication and mailing of about 200 fliers

to UHM faculty (open market cost about 35 cents per sheet) and the cost of locally FAXing about six pages of information to the core group during the creation of the promotional flier. These expenses were absorbed by CTE in support of the MultiMedia Inquiry Group.

6.2 THE DEPARTMENT OF EDUCATION - DISTANCE LEARNING TECHNOLOGY PERSPECTIVE

The Global Classroom teleconference demonstrated how the myriad pieces of technology fit together. Dr. Johnson had previously been a guest speaker for some of our Hawaii schools, via the still-frame videophone. Students from several different schools had conducted audio conferences over the PEACESAT telephone bridge. Other students had visited PEACESAT and were able to talk with people in the South Pacific via radio transmission. Department of Education staff had used HITS to conduct two-way interactive conferences on various topics throughout the year. Students on five different islands had received one-way video and two-way audio during an Advanced Placement Calculus class over HITS between the islands and through the public access channels of several different cablevision companies across the state. The April, 1991, teleconference was the first time we were able to simultaneously utilize all of these methods of communication, plus a few others, such as voice over satellite. Although all schools didn't actually participate, the teleconference potentially could have been viewed within the state of Hawaii by over 90% of our schools and 75% of the homes.

We have learned from the teleconference that mixing of technologies can work, and it vastly expands the areas in the world that can take part in such a conference. In education, we must provide teleconferences that can be shared nearly everywhere regardless of the sophistication of the technology in that location. This teleconference did just that.

The one area observed in this and in other teleconferences that may improve future teleconferences would be to break the lecture paradigm. As an example, it may have been more meaningful if Dr. Johnson's lecture (which was excellent) had been on a videotape and distributed to all sites for viewing prior to the actual teleconference. Then the interactive part of the teleconference could be done as we did it during the Global Classroom event.

6.3 HaSTA'S TELECOMMUNICATIONS EXPERIENCES

The Global classroom event materialized from an initial request made by a HaSTA member for a workshop on using Distance Learning--Technology resources. It was appropriate that it be broadcast across the state of Hawaii so that HaST members could view the event. It is not surprising that such a request came from this group since HaSTA has over a decade of experience using various forms of telecommunications technology. In the early 1980's a newly-elected president of HaSTA suddenly had to move to the island of Hawaii. Typically, the HaSTA officers were from the island of Oahu. Instead of electing a new president, HaSTA board meetings were run by its president via audio speakerphone from Hilo. The meetings were even more effective and efficiently run than the all face-to-face meetings on Oahu. Ten years later HaSTA has again begun using telecommunications for its monthly board meetings. Now HaSTA neighbor island representatives are able not only to hear each other but also to exchange still, black and white images with the other HaSTA board members meeting on Oahu. The Hawaii DOE has established audio/videophones in all public schools in Hawaii. These have been made available for these and other meetings of professional groups to permit teachers and students statewide to actively participate in their organizations.

Another aspect of telecommunications formerly used by HaSTA involved electronic mail on a University of Hawaii computer to submit articles for the periodic newsletter. Members having news for the editor can easily send it by computer mail thus saving the editor from having to retype the news items. With electronic mail systems now sponsored by the DOE, this technique is expected to resume once again.

In 1989, the HaSTA Chemistry Section created an electronic bulletin board on another UH computer for use by any of its members needing or having information regarding chemistry education. This has been used to allow some of the individual members to organize "electronic field trips" using techniques via computer, audio and videophone to provide classes information about careers, scientific research, and environmental issues.

7. POST-EVENT OUTCOMES AND FUTURE DIRECTIONS

In addition to the grant application that was discussed in the PEACESAT PERSPECTIVE section, there have been other outcomes. The success of this inaugural cooperative effort has led to the establishment of an informal association of the cosponsoring groups called the International Telecom 21 Project Advisory Council. Through periodic electronic mail exchanges, the group has maintained contact in expectation of sponsoring similar projects using interfaced multimedia telecommunications technologies. In the fall of 1991, HaSTA, in cooperation with the Hawaii DOE and Hawaii FYI computer network, set up a statewide bulletin board called Science-Technology-Society (STSBB). Anyone with a computer and modem can (1) establish a free account on Hawaii FYI and (2) use STSBB to read or write messages via a free statewide phone network. Ironically, though designed mainly for Hawaii residents, the first item entered on STSBB came from Sanger, Texas!

From the Global Classroom event, we have discovered an exciting way to work together

in developing innovative means of information exchange on a local, regional, national and international basis. Different perspectives from those involved, when shared cooperatively, will indeed expand horizons for linking people around the globe.

Special thanks to Joy Shirokane, Lisa Poulos, and Susan Pang for their technical knowledge and skill. Special thanks to Joyce Ogawa for her help in preparation of the manuscript.

Evolving Educational Environments: A Projected Impact of the Recent Digital Revolution

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1. ABSTRACT

Digital Revolution has influenced most aspects of our lives. The computational opportunities abound. The communications facilities have networked most computers. Personal computing has reconstituted our rationality. Numbers have become a language of their own and so on. The general impact of such an explosive change depends upon the structure of the culture absorbing the effects. However, the educational environments are particularly important since education and reason have been intertwined to discard bias and ignorance. In this paper we examine the dynamics of the profound technological change within the context of educational systems ranging from the kindergarten to the doctoral research centers.

2. INTRODUCTION

Traditionally, educational environments have been confined to schools, colleges and universities for instructing students. Modern communication systems have a special role in the society since dialogue (an interactive process) is gradually replacing learning by osmosis (a more subdued and passive process). We integrate these incipient effects that the computer and communication systems are bringing into the educational environments and present the emerging changes. The influencing factors ranging from stand alone micros to classic networks are matrixed onto the educational institutions ranging from grade schools to graduate centers. The impact of recent significant innovations such as ROM disc and modern AI languages will also be presented in the main body of the paper.

Some products and technologies will be more significant than others in different sectors of the educational environment. In this paper, we will isolate the nature of impact of network technology upon collective group research and contrast it with the nature of the impact of passive information retrieval environments such as grade schools.

3. SUMMARY OF MAJOR SOCIO-ECONOMIC INTERACTIONS

When two major and influential components negotiate an interactive process, four distinct stages of interaction are generally identified. First, when the interaction starts to emerge, there is a phase of superficial enthusiasm in which rather uninformed parties play up the major benefits that can be derived by the interaction. At the stage, since the process of interaction is not visualized in any detail, the process is seen as being one-sided, and the emphasis is focused upon what the impactor is going to do to the impacted. These benefits are exaggerated to convince powerful socio-economic groups. A certain amount of financial and power-base is built to manage the infancy of the interaction process.

Second, when a substantial amount of resources have been expended in building a pioneer system (which essentially is a forced fit of the impactor upon the impacted) to realize some of the benefits of the first stage of the interaction, many well informed experts scrutinize the entire process from both (the impactor and the impacted) points of view. At this second stage, the process is stream-lined and the experts attempt (to some extent) to make the next system graceful, integrated, efficient and optimal. Redundancy, waste, and sub-optimal design of sub- systems are generally eliminated.

Third, when the system is functional yielding marginal results, the age old rules of micro-economics are applied to the composite impactor-impacted system. The benefit-to-cost ratio of the system (as it exists at this second stage) of its evolution are scrutinized by accountants and managers. Now the experts already on board in the second stage propose a more cost effective integrated system which is designed from its very conception and from both points of view to satisfy the needs of the impacted and the technological limitations of the impactor. Since the recipient and the beneficiary of the system is likely to pay the price of the system, considerable managerial authority is exercised in having an acceptable, optimal and profit making system.

Finally, when the new system is designed and constructed, experts from both disciplines would have fused their resources, goals and expertise to offer an new environment which becomes well integrated and well founded. This system now becomes a platform for other incremental changes that technology may bring to a mature and established technology in its own right. We foresee that the new educational environments of the future can be only be evolutionary (like our communication systems) and are likely to exhibit these stages of evolution. It is our hope that the path towards the new educational environments of the twenty first century can be shortened and streamlined by early cooperation between experts from the digital industry now in an explosive phase of expansion and the gurus of educational systems who are willing to accept ideas but reluctant to implement the change.

These four stages of evolution have occurred in many areas where the impactor can substantially modify the impacted. Typically in the evolution of the automobile industry, the four stages can be identified as (a) realization of the internal combustion engine to provide the motive power, (b) the motorized horse-carriage, (c) the redesign of the internal combustion engine for automobiles and (d) the stream lined auto. Aircraft industry, farming industry, war and defense industries all exhibit such stages before maturity is reached. In other cases where these four stages are discernible are the credit card, microcomputer, and communication (all aspects from signalling, switching, transmission, to optical systems) industries.

These stages occur only if the two interacting components are significant, balanced and have the potential to modify each other. When one is insignificant compared to the other the process becomes absorption and the consequences are not worth the study. When the power balance is biased, the the duality of the modification process leading to greatly rewarding mutual benefit is stifled. The four stages of modification are more likely to be present in democratic and open societies leading to an accelerated progress towards optimal system.

All these four phases of the interaction process may not be discernible in every situation. In some cases (e.g., robotic technology in Japan), a quantum jump from the first stage to the fourth stage in one rapid leap may be evident. The impactor and the impacted have distinct technological, economic, social, and cultural bounds which influence the intensity and the duration of these aforementioned stages. In some cases, (computers in medicine) multiple ripples can also be identified. Where the interaction between the impactor and impacted (e.g., fiberonics and communications, optical processing and computing, etc.) are based upon the solution of crucial technological breakthroughs, each partial solution causes a ripple of its own. These stages of oscillatory convergence to an optimal state (if there is one) are simply a manifestation of the migration of one stable operating condition to another due to a profound change in the environment.

4. DIGITAL REVOLUTION AND EDUCATIONAL ENVIRONMENTS

Here the impactor and the impacted both have enormous inertia and can dramatically influence each other. If the interaction is only circumstantial, then the path of progress is likely to littered with exploiters, whose objective is to secure a financial gain while the encroachment of digital revolution upon the educational environments occurs undaunted. On the other hand, if the optimal modus operandi in envisioned, then the path of progress can be demarcated by clear cut milestones and the transition can indeed be smooth. One example where the global communication industry has established such well accepted milestones (the common protocol, the signalling network, the stored program controller to monitor the switching functions, etc.) is the phased introduction of Integrated Services Digital Network (ISDN). The second, perhaps the more profound example in the establishment of the Open System Interconnect (OSI) model for communication.

4.1 Discussion of the Educational Environments

There are three major factors shaping the nature of the impact of the digital revolution upon the educational environments. First, consider the digital revolution as it has influenced the computer and communication field. In context to the educational systems, the three major consequences of the digital revolution are (a) modern computing systems, (b) modern communication networks, and (c) modern mass media systems.

Second, consider the educational environments that become the recipients of the impact. The effect can vary significantly in three basic aspects of educational systems; (a) nature of the education provided and the educational facilities (kindergarten to doctoral centers), (b) the spectrum of disciplines taught (fine-arts to abstract/mathematical sciences), (c) and the extent of emotional support required to teach (occasional touch-contact to purely factual communications). Fortunately, to a certain extent natural grouping exists, i.e., in the kindergarten, a low level of all disciplines is taught with a high extent of emotional contact or conversely, a highly selective discipline is communicated (or discussed) with no emotional content in doctoral centers.

Third, consider the integrated effects of the impact per se. Here again, it can be visualized that considerable simplicity can be attained by limiting the areas of study to include only highest impact. For instance, the ROM disc technology is likely to impact the lower end of the educational spectrum since the communication is not likely to be oriented towards interactive global database

search thus curtailing the impact of communication networks on kindergartens, and highly emotionally supported environments are not likely to be globally networked. Conversely, in highly directed research center where factual information is exchanged there is little or no emotional counseling. Where the discipline taught needs high reason and logic, the need for fourth generation languages and their compilers may be identified.

However, in a general sense, every technological aspects will each interact every educational environments thus splintering the systematic appraisal into too many different areas of study. If a certain attribute of the educational environment is likely to be strongly influenced by the technological revolution, then the effect of the impactor has to be interwoven with other (similar) effects of impactor-impacted interaction. The four stages of the evolutionary process thus gets modified by the ripple effect of similar stages of other interactive processes.

5. BASIC SYSTEM MODEL

For the basic model in this study, we have borrowed the concept from decision support systems. In this version, the model (Fig. 1) consists of three major components: (i) a front-end processor to deal with the dialogue between the user of the system (student in this case) and the system (machine based educational systems (MBES) whose attributes will be developed), (ii) a knowledge-base manager with an internal knowledge base and an external knowledge base, and (iii) a model manager that fits the query of the user in a mathematical context to query the knowledge bases and provide a piece of information back to the dialogue manager. The process may cover numerous transactions involving the participation of the three major components. The student learns to ask the right question to the dialogue manager over a period of time. This process of learning the communication skills occurs elsewhere in society. The system handles complete queries the first time, but interacts with the student till the query is complete in the interaction mode. In the forward communication mode, pertinent information for the "course" that is being taught will be presented as a "teacher" would present it to the class.

This model lacks the ability to provide human-emotional component of the kindergarten environment. For this reason, we have modified the model (Fig. 2) to include a configuration that includes teaching (or even nursing) staff that can provide dialogue, model and knowledge base capabilities at a human level. When the query is rudimentary the human systems with the same three functions will suffices. When artificial intelligence is invoked by higher level students in the query process, the system will suffice. In the real world, it is to be appreciated that a blend of the two will be necessary to handle the overall educational spectrum. This brings us to the first model of an instructor assisted MBES which is much like a classroom full of networked computer workstation with one or more instructors to complete the needs of students that need a "teacher".

5.1 Role of the Communication Networks

The modified model shown in Fig. 2 or its derivate has all the attributes for the educational systems. The network aspect has numerous impacts. The knowledge bases can be widely distributed and accessed via a LAN, MAN, or a WAN. Likewise, the query points can also be widely dispersed and may access the "classroom" via a network, and the model matching can be done at any location. The class thus becomes a collection of access points and the MBES becomes a logical network which will invoke "teacher" assistance if there is need for a real human tutor or a video portrayal of the "long-distance-professor".

5.2 Role of Microprocessor Industry

Microprocessors for the implementation of basic function in all the basic components (networks, intelligent terminals, local and remote data base managers, etc.) of the model in Fig. 2 are essential. The function and feasibility are not the issue, but instead the cost and real-time response time that make the hardware adept for the MBES. Microprocessors and customized chips will appear for MBES over a period of time and will facilitate the smooth "class-room" functions over the logical network that could function much like any other data communication facility.

5.3 Role of CD ROM Disc Technology

This recent technology makes the concept of MBES a step closer to reality by reducing the access time and network costs for a large fraction of "classes" for the lower end of the educational environments. Any documented and published information becomes immediately available the "class". The plummeting cost of encoded CD's and the low cost of access to a centralized mass storage system makes massive amount of information available to every class.

5.4 Graphic Interfaces and Video Compression

Both have a significant impact on display and access costs. Video compression and the subsequent access of paintings and major performances opens new doors to the study of fine arts. Such facilities are now feasible in classrooms and in real-time. Access by individual students to scrutinize major plays and performances can be provided via MBES to any high speed display device. The emerging high definition TV (HDTV) standards can only enhance the use of graphics to provide a visual mode of communication to the students in all stages. The learning process is thus accentuated by a perceptual reinforcement and video sequencing. The MBES is capable of providing this mode of learning to students with various learning abilities.

6. EXISTING PLATFORM FOR MBES

It is easy to see that there is no real obstacle to building a local MBES for a campus based university or for that matter an urban university such as the City University of New York with numerous colleges. However, when the geographic areas are vast and information is widely dispersed, network architecture and control can pose an implementational problem. For this reason, we have investigated the architecture, control and implementation of Bellcore's IN/2 (Intelligent Network II, Fig. 3). We see that all the functional requirements of MBES can be handled by this architecture. The architectures of Bellcore's IN/1 and IN/1 + are nor considered since the concept of "service programmability" is absent. It is our belief that having this flexibility via the service logic interpreter (SLI) permits the development of new courses and individualized teaching styles of different faculty members.

The functionality of the STP/2 also need some modification. The reason is that the database for signal transfer point has to be subject/concept-driven and not address-driven like in the conventional IN/2. We do not see this as a major concern because the disciplines have been already grouped hierarchically. Such hierarchies (such as the Dewey decimal scheme) are used by most libraries. To take advantage of the design and feasibility studies by numerous operating companies and Bellcore, it is proposed that any questions from the "class" be identified by the subject/concept content. When the root of the query is identified, then the location of the database or the "expert" be then obtained from the service control point (SCP). The access is then complete via the routing information thus secured over the signalling network. This part of the educational network will be the same as any other intelligent network.

At the implementational stage we do see two problems of an ill-defined MBES. First, the identification of the root can be misdirected by the lack of complete information about the question from the "class". Second, far too many databases and "experts" may be identified. Both these problems are not surmountable if the search procedure is delayed till the "student" is queried enough by the dialogue interface to properly the nature and the subject content of the question. The teachers in conventional classrooms use this procedure, when the student asks a question that is incomplete or irrelevant to the topic under discussion.

If a universal educational environment should be able to handle all "classes" ranging from kindergarten to graduate centers in all the subjects with open student enrollment, then it appears that new constraints are necessary. New standards, protocols, and functional layers for the MBES environment will be essential.

6.1 A New Open System Educational Interconnect (OSEI)

If a new OSI environment for the MBES "class" is necessary, then protocols for MBES functions have to be developed. One of the initial steps would be to define the architecture of the MBES. In Fig. 4 we propose a single knowledge base global MBES. Miniaturized versions of this will serve a campus. Versions of these separated by subject matter can be shared by many universities. Individualized versions of these can be built by each faculty members to be responsive to department needs for registration, advising, and administrative tasks. Modifications to these knowledge bases is effected on an incremental basis by the "expert" faculty committee. It seems that a whole new creed of knowledge worker may be initiated at both the faculty and the student levels.

In the conventional OSI model, the application address is provided by the user. In the OSEI, the dialogue manager (local or networked that monitors the student interaction via his intelligent terminal) provides the address of the database or the "expert". Hence we see that the communication in the OSEI is a two step procedure. First, an AI based network interface acts as a buffer between the knowledge bases and the "students". Second, the information to identify the right knowledge source is interpreted from the query and it is at this stage that the address translation takes place (via the STP and SCP of IN/2 architecture) and the physical address of the source is used to secure the information sought. This information is then extracted and communicated to the student till the all phases of interaction (spanning numerous transactions) between the student and the MBES is complete.

For privately owned MBES's the protocol and the knowledge base search need not be optimal, even though standard interfaces and dialogue handlers will will permit quicker expansion and integration of many MBES's. However, "classes" operating under standardized education platform will permit globally dispersed students to be educated by globally dispersed knowledge bases, faculty or "experts". The deployment of MBES's is likely to follow the evolutionary pattern of any other communication network starting locally and growing steadily. It is also likely to make the students think coherently, logically and precisely to interact with the MBES (which is itself a coherent, logical, and a precise system). This aspect of student learning is similar to that of the students learning to program in a new computer language or children learning to interact with their "teachers". However imprecise the query patterns may be during the initial learning phase, they are going to become precise and optimal over a period of time. We do not see this as a problem since all early man-machine interactions are far from optimal. Learning the precise MBES dialogue is a step towards achieving proficiency in the students knowing what is it that they want to know.

For low level educational environment (such as grade

schools), the MBES needs considerable human component at the dialogue interface level and the requirement can be easily built in the physical class rooms with a blend of real teachers and intelligent terminals. Individual attention and emotional care for students is necessary. It is our hope that the actual communication of factual information to these young students (by the real teacher) will be reduced considerably and these teachers will be there to provide the human aspect of the learning environment (typically, motivation and care) to the students. Facts, documented information, video pictures and other nonemotional education will by communicated by MBES.

6.2 Implementation of the MBES

The introduction of the MBES will not be smooth process in the unionized school systems and the problems in these schools will be similar to those encountered by automobile manufactures approaching a automated, streamlined and robotic facilities. Such transitions have occurred in coal mining and steel industry, are occurring in auto industry, and have already occurred in computer industry in the US. Resistance and fear from those unwilling to undergo the change and retain the status quo is documented in all aspects of socio-economic interrelations between the participants.

6.3 Proposed Partial Implementation

The standards are absolutely essential to build and integrate a universal MBES. However, small campus wide MBES's can be built to evaluate the feasibility and the student response to the system. This phase of the introduction will facilitate the design and development of the "dialogue processor" to interface the students and the system. The range of variation of this dialogue processor can vary significantly from subject to subject, from class to class, and from culture to culture. Hence any design experience in building this dialogue processor can only benefit the effective usage of the overall system.

7. CONCLUDING REMARKS

We have presented an approach to computerization and networking of the educational environments. The role human emotion in teaching and learning is not undermined; instead the role has been identified and given back to human beings. Mechanized systems are limited to the delivery of knowledge in a methodic and systematized way while "teaching" and to the practice of artificial intelligence, information retrieval, and providing the information to the "classroom" or to the individual student in a rational, logical and coherent fashion instantly and inexpensively. These systems relieve the human teachers of being emotional and rational at the same time. The technology to take this bold step forward appears is here; the question yet unclear is whether the society can accept new ways to teach and learn effectively.

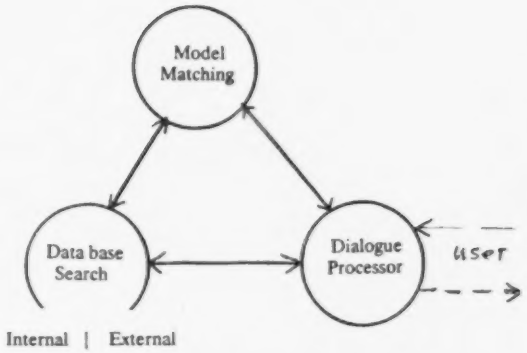

Fig. 1. Model of a Decision Support System.

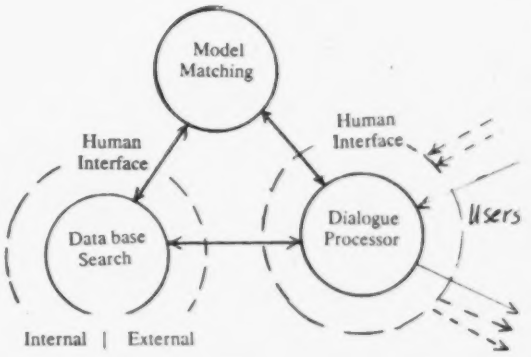

Fig. 2. Modified DSS to include human assistance at the Dialogue Processor and for Database Search.

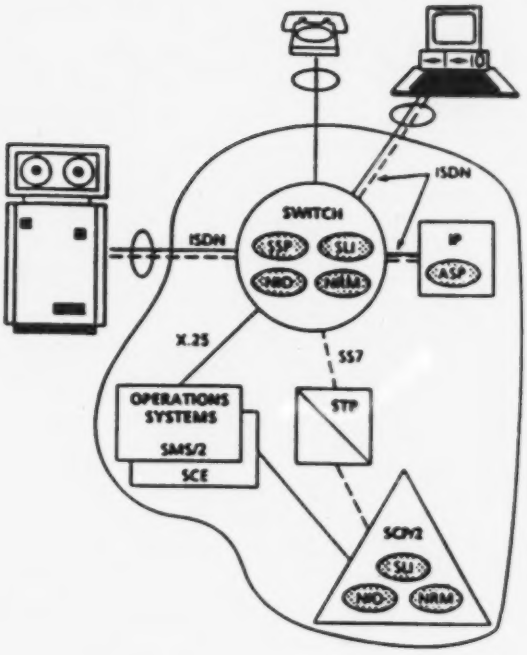

Fig. 3. Typical Architecture of Intelligent Network (IN/2) SLI Service Logic Interpreter; SCP Service Control Point; STP Service Transfer Point; NRM Network Resource Manager; NID Network Information Database; SSP Service Switching Point; SMS Service Management System; SS7 Signalling System 7; SCE Service Creation Environment; X.25 protocol for signalling and control of network. ISDN integrated service digital network lines. ___ Transmission Path; ---- Signalling Path.

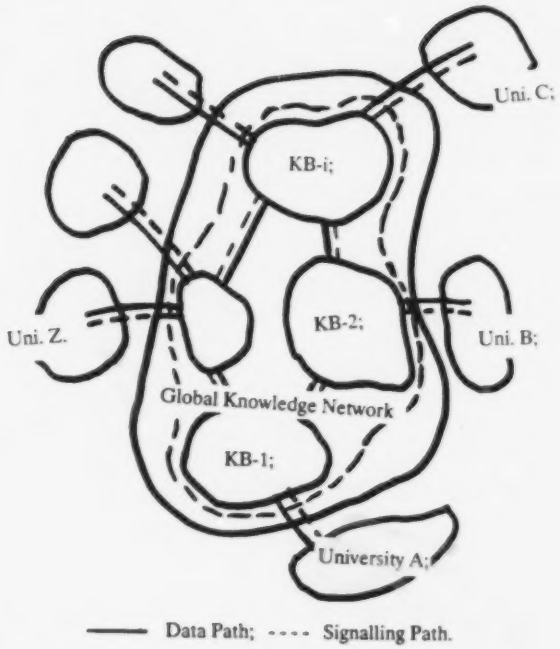

Fig. 4. A Proposed Architecture for MBES with Open System Educational Interconnect. Here the various universities have access to networked massive knowledge base. The front end processors at the universities have the "dialogue processors" and pass only pertinent queries to the knowledge base network. The "model matching" (depending upon the subject matter of the query) may be handled in the knowledge network or at the local universities. The authorization code supplied to the univerisities will permit or deny access to the users.

THE ROLE OF KNOWLEDGE TRANSLATORS IN TELECOURSES: A CASE STUDY

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ABSTRACT

The University of Saskatchewan telecourse model attempts to create a positive teaching/learning environment that utilizes a team of knowledgeable and caring "knowledge translators." Television instructors, assisted by a team of local facilitators, help groups of widely dispersed students learn the skills required to translate new information and ideas to contexts that are personally meaningful. The rationale behind this distance education model and the experiences resulting from the delivery of telecourses in English, History, Psychology, Mathematics and Native Studies are discussed.

Teaching and Learning at a Distance:

Distance education has emerged in the last 20 years as one of the fastest growing areas of post-secondary education in both advanced industrial and developing countries. The primary attraction of this form of education is on its potential to improve equality of education opportunity through increasing access to large numbers of people and to various disadvantaged groups. The nature and structure of distance education varies between and within countries, but the processes and techniques adopted all aim to free learners and educators from the temporal and spatial constraints of traditional education.

While distance educators have tended to appeal for government funding and support by focusing on the the potential ability of distance education to provide cost-effective education and training for large numbers of people without massive geographic and social dislocation, the efforts of many distance educators have been concerned with the individual learner. The distance education literature is filled with accounts of the struggle to personalize the teaching/learning materials and the relationship between spatially separated teachers and learners.

Providing education to students learning at a distance involves a variety of activities which can be categorized into two phases: (1) the design, development, physical production and storage of instructional materials; and (2) the bringing of learners into contact with the materials and resources relevant to their learning. (Pratt, 1987). Although the rapid growth of instructional technology has provided educators with a wide range of media to achieve the these tasks, one teaching function poses a special challenge--- that of stimulating student interaction at a distance. Within university distance education, various institutions have developed courses using different combinations of print, audiotapes, videotapes, satellite and cable television, radio, microcomputers and the telephone.

A review of the research literature reveals that most teaching functions can be performed using most any one of the above media. When one medium is compared to another for effectiveness of instruction in any given subject matter, significant differences are seldom found. When it comes to learning, however, there is commonly more variance reported within than between media, leading to the conclusion that how a medium is used in the learning process may be more important than what medium is used. Factors that influence quality of learning in face-to-face settings also influence the quality of learning where educational media are employed (Clark, 1983).

Telecourses in Distance Education:

Since the establishment and public success of the British Open University, post-secondary institutions around the world have emulated their practice of preparing courses for students living at a distance from the main campus. While television broadcasts played a prominent role in providing a "window on the world" for the Open University students, the high cost of television production has prohibited many institutions from using the medium extensively as part of a multi-media teaching package. Television, as a technology, has evolved into many forms. In addition to microwave or cable, it is now possible to distribute the signal via satellite or fibre optics. Videocassettes, video discs, and microcomputer-based systems all enhance control and flexibility for the learners.

From the institutional perspective, the presentational strengths of television is often less important than its distribution potential. In an era of concomitant budget constraint and community demand for access to higher education, the use of low-cost television to reach students located at a distance is an attractive alternative for educational planners. In the 1970s, Stanford University in California pioneered the relay of classroom lectures to a range of different sites where local face-to-face tutors handled questions following the viewing of a lecture. This method is called Tutored Video Instruction (TVI) in Britain and has been used extensively for the continuing education of various professional groups.

In Canada, our Maritime universities, via the DUET system (Distance University Education via Television), successfully

used one-way videoconferences to deliver courses to distant students in the early 1980s. A television signal was sent by cable to designated locations with a return telephone link to the studio classroom. Telecourses in the mid 1980s (e.g. courses produced by the Knowledge Network of British Columbia and TV Ontario) incorporated live-interactive television with other learning materials such as student study guides. Live, interactive television has been defined as "that which is offered via satellite or microwave delivery systems in real time to students, with immediate talk-back capability with the instructor" (Whittington, p. 47)

The University of Saskatchewan Telecourses:

The model developed by the University of Saskatchewan draws on the experience of other institutions but has incorporated certain unique features. Like some other institutions, we provide the students with an opportunity for live interaction with the television instructor as well as access to student support services such as telephone counselling and on-site tutors. Unlike many other institutions, our television signal is "narrowcast" to designated sites such that the programs are not available to the general public. The insistence on a learning group based at specific locations reflects our believe that learning in higher education is facilitated by an opportunity to develop skills of analysis, interpretation and application in the company of learning peers. We fully realize that this is done at the expense of student control over time and pace of study. However, evaluations conducted over three years (Wong, 1988; 1989; 1990) have shown us that the majority of our students feel positive about this approach. They appreciate having access to some of the best lecturers on campus, and many feel they have developed a greater sense of affiliation with the university.

Like some other universities, our choice of television as a medium of instruction has been based on a number of economic and political factors in addition to pedagogy. The small and widely dispersed population of Saskatchewan (about one million people in a province three times the size of the United Kingdom) makes it financially unfeasible for the university to offer face-to-face courses in many small rural communities. In 1987, after several years of increasing enrollment with no corresponding increase to the university program budget, our College of Arts and Science imposed a quota which resulted in hundreds of qualified students being turned away. When a "seat sale" on the satellite Anik C was offered by Telesat Canada, our administrators decided to invest in the development and delivery of introductory English and History courses to 13 rural communities. The success of the pilot program resulted in the addition of courses in Psychology, Mathematics and Native Studies over the next three years. All of the television instructors had reputations of being excellent teachers as well as scholars in their disciplines. The recent establishment of the Saskatchewan Communications Network (SCN) has provided further government funding and a mechanism for province-wide delivery of our credit telecourses to over 50 learning sites.

The basic format of the weekly telecourses consists of a 10-minute orientation and review at each local learning site, a 60 to 90-minute live television presentation, a 30-minute off-air discussion led by a local facilitator, a 30-minute on-air discussion with the instructor, and a 10-minute wrap-up at each local learning site. The orientation and wrap-up are conducted by facilitators recruited from the local community. Dramatic vignettes, slide shows, video clips and interviews are pre-produced and incorporated into the live television presentations. The students could also consult the instructors individually via toll-free telephone lines at other designated times of the week. Each telecourse is complemented by a course guide, a package of readings, and a variety of textbooks.

The Role of Knowledge Translators:

The emphasis placed on the cost efficiencies and universal access which distance education methods and technologies can achieve often detracts attention from the need of individual learners to gain control over their lives and environment. Designers of telecourses often attempt to meet the needs of individual learners by selecting teaching/learning strategies that promote dialogue between the teacher and the learners as well as among learners. The recruitment of local facilitators for the University of Saskatchewan telecourses reflects the designers' concern with providing learners with assistance to relate and apply new knowledge and skills to relevant contexts, for example, "How do 19th century Victorian love poems relate to life in rural Saskatchewan?" and "How can the concept of differentials be used to estimate how much ice has collected on my grain silo?" The television instructor, as the subject matter expert, is the chief "vehicle" for helping the students bridge this gap. Given the spatial separation of the instructor and the widely dispersed learners, other facilitators can be recruited to guide this quest for personal relevance.

There are a number of models which are useful for identifying the instructional elements which contribute to this teaching/learning process. Pask (1976) formulated a "conversational theory" that states that learning occurs during "conversation", or interactive dialogue among participants in the learning process. Holmberg (1983) contended that distance education should have the spirit and atmosphere of a conversation between the students and the supporting organization. Students can have "real" interaction with instructors, tutors and counsellors via written and/or telephone exchanges as well as simulated interactions via pre-produced course materials. Real learning, however, is primarily an individual activity and is attained only via an internalizing process.

George Beal (1982) made a distinction between knowledge acquisition, the process of learning facts and new ideas, and knowledge use, the process of learning how those facts and new ideas can be applied in a real-world situation. In knowledge acquisition a person accumulates information. In knowledge use a person learns the skills required to use it and makes judgments about the relative value of information accumulated. He identified the need for a role of "knowledge translator" to be performed to help students relate new knowledge to the context where it will be used.

The experience of distance teaching institutions such as the Open University in the United Kingdom, Athabasca University and the Open Learning Agency in Canada has demonstrated that strong student support is essential to high completion rates (Kaye & Rumble, 1981; Mugridge & Kaufman, 1986)). All of these institutions provide regional tutors for their distance learners. Under the Open University model, the role of the tutor is that of a subject matter expert who provides all assistance related to course content, including "translating" the learning material and marking assignments. The tutorial relationship is essentially one-to-one, and communication between tutor and learner is usually conducted in writing and by telephone.

Under the University of Saskatchewan model, the tutor is a local facilitator who is not expected to be a subject matter expert, but is charged with the responsibility of assisting

groups of learners find the contexts for understanding the information presented by the television instructor, as well as assist the latter in monitoring the learners' progress in integrating the new information. The tutors assume the role of knowledge translators who live in the learners' community and can empathize with many of the learners' experiences and problems. They stimulate dialogue by helping the learners to pose questions, debate different perspectives and seek clarification from the television instructor, the principal knowledge translator.

The Contribution of Local Facilitators to the Learning Environment:

Tutors were hired according to two criteria, relevant academic background and previous experience with adult learners. The criterion of "relevant academic background" varied among different subject matter and was influenced by the academic tradition of particular departments. Both English and History required the tutors to have a master degree in the subject or a cognate area. Because of Saskatchewan's small population and the project's intent to deliver the courses to small rural communities, the administrators experienced difficulty in recruiting enough local tutors with a master degree. A compromise was achieved in the decision to hire "proctors" (with an undergraduate degree) who could lead the local discussions but would not mark assignments. In the latter case, the assignments were sent to the main campus to be marked by the instructor or a campus-based tutor. In the Psychology and Mathematics telecourses, the respective academic departments were more concerned with recruiting tutors who had the practical skills to facilitate problem-solving. Most of these tutors had an undergraduate degree.

From the designers' perspective, the criterion of "previous experience with adult learners" was as important, if not more important than a relevant academic background, given their awareness that one-third to one-half of the target learners were mature students in the 30 and above age range. One of the most highly rated tutors was a farmer with an undergraduate mathematics degree. He was a father of three young children, an organic grain farmer, part-time student, and part-time statistics consultant. Many students credited him with motivating them to "stick with it" as well as helping them with their math. A History proctor was a retired high school teacher whose passion was travelling to the birth places of famous European historical figures. For many years, she had read all she could find on selected notables and places, saved her money over one year, and travelled during her summer holiday. Her love of History was infectious and the students in her region had one of the highest retention rates.

The ability of the local tutors and proctors to understand and empathize with the culture of their students was especially important in the Native Studies telecourse. The content of this course was the result of a collaboration between two departments with somewhat different traditions and student audiences. The latter included both school teachers as well Native learners in a special university access program. The designers were given the information that the Native learners' culture had prepared them for a more process-oriented learning style which included intuitive modes of thought, reflection and silence. It was therefore crucial to hire facilitators who could help these learners translate conventional university learning styles to their own contexts.

At the beginning of each academic year, both tutors and proctors are invited to the Saskatoon campus to participate in a one-day workshop to orient them to the design of the telecourses, to familiarize themselves with their expected roles and functions and administrative procedures, and to be introduced to the studio facilities where the classes will be narrowcast. In their respective group discussions, the instructors of the telecourses stress the importance of the local facilitator's role in stimulating interaction locally as well as on-air during the question period. While they are not expected to be subject matter experts, they have to keep ahead of the students in the reading assignments and provide feedback to the television instructor about how the students perceived and understood his comments and interpretations.

In the pilot year, a survey of the local facilitators was conducted three months after the initiation of the project. The results indicated that while most of them felt that their roles and functions had evolved as they had expected, two tutors expressed personal dissatisfaction with their role as facilitator. Both tutors had previously been hired as off-campus sessional instructors in their communities and appeared to have difficulty adjusting to the "downgrading" of their status. Feedback from the students confirmed that one individual in particular spent the discussion period challenging the television instructor instead of helping the students identify questions and exchange views in relation to the new information presented.

In contrast, proctors and tutors who had no previous experience in teaching university courses expressed personal satisfaction in their contribution to the project in spite of the amount of time they needed to commit to preparing for the course and facilitating the discussion:

> "I am fulfilling my function as proctor exactly in the way that I anticipated when I accepted the position...While they are reading, thinking and writing about a piece of literature, the students use me to check their perceptions. Although I am not able to answer their questions with any real authority, the talking helps. We can bounce ideas off each other and together, are able to come up with some very legitimate interpretations (confirmed by the instructor). My group, and I expect it is typical, is insecure about English and particularly writing. This group has needed a great deal of support, encouragement and my time...I must say I've enjoyed every second of it." (English proctor)

> "A very positive experience...participating in what is a very good idea. The students appreciate the fact that they are getting first class instruction on the same level as students in Saskatoon. They do not get the feeling that they are in some way second class students. I personally find the lectures interesting and informative...Michael (the instructor) lectures very well. He is interesting, well organized, and he gets his material across very well...The reading, preparation and thought that must go into each week's presentation is very considerable...Unfortunately, for me, I must take this time away from my family." (History proctor who signed up for 3 more years)

The local facilitator's contribution to the learning process can be illustrated by the following student comments:

> "I am really enjoying my English class, it truly helps when one has a proctor as helpful and enthusiastic as J.Q."
> "Our tutor puts herself in our shoes...she helps us to understand our questions a lot better...and is helpful on an individual basis."
> "Compared to other classes, it's very important

to have a tutor...Mr. C. is very helpful...without him, I wouldn't have known how to do my assignment on *The Prince*."

Students were also appreciative of the facilitator's help in making calls to the studio during the interactive period with the instructor. During the first few weeks of a telecourse, students usually feel intimidated by the thought of being heard across the whole province. The local tutors and proctors therefore serve as role models in conducting a dialogue ---an exchange of opinions among individuals who achieved different but equally valid interpretations of the lecture and reading assignment content. This exchange quickly expands to include some enthusiastic student callers. A growing concern of the television instructors as the number of learning sites increased is equitable interaction. The English instructor solved the problem by targetting questions to specific receiving sites on a rotation basis. The tutors and proctors of the students who were not on the "hot seat" noted the local reactions and relayed them to the instructor during their staff conference calls. The instructor would then attempt to incorporate these comments in his next lecture and discussion. This strategy was later adopted successfully by both the History and Psychology instructors.

Conclusion:

Our experience with the first four courses has provided our university with some evidence that it is possible to deliver quality instruction to a small, widely dispersed population via a combination of human resources and television and telephone technology. Technology, in this case, served the role of agents of interaction. The task of stimulating interaction at a distance relied primarily on the human resources, the television instructor and the local facilitators, who served as knowledge translators in helping the students find their way through a body of knowledge. To achieve this, the television instructors had to master a variety of television presentational and questioning techniques, while the local facilitators had to learn to unobtrusively encourage students to participate in the interaction. In our experience, the best facilitators are those who have received a thorough orientation to the rationale and design of telecourses and who are personally committed to complementing the television instructor's message with their individual perspectives rather than competing with him as content experts.

As the number of learning sites increased dramatically over the last three years, the recruitment and training of the local facilitators became problematic. The need to respond rapidly to new clusters of rural learners meant that some local facilitators were not hired until after the orientation workshop had been conducted. In spite of the availability of an extensive package of print information, these late comers did have receive the benefit of the television instructor's personal introduction to the course content or the opportunity to establish social affiliation with the course team.

The dual hiring criteria of relevant academic background and experience with adult learners were not met in some cases. To achieve parity of esteem with on-campus courses, the telecourses had to have facilitators with equal or better academic qualifications. Some local facilitators had the appropriate academic credentials, but turned out to be less than ideal in their ability to motivate and facilitate adult learning. In other cases, facilitators who were committed to the principles of adult learning were greatly discouraged by the attitude of some students who wanted to get high marks but were not interested in the discussions.

The University of Saskatchewan model attempts to create a teaching/learning environment that utilizes a team of knowledgeable and caring knowledge translators. In spite of a few unsatisfactory cases, the inclusion of local facilitators as knowledge translators has enhanced the profile of University of Saskatchewan distance education courses in small rural communities, and has contributed significantly to the quality of student support services to our off-campus students.

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"The Telecom/Computer Partnership"

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Integration is the dominant trend in both the telecom and the computer industries. And integration of these two areas of technology is also a dominant trend. Together, telecommunications and computers are reshaping not only business enterprise but human enterprise. I'd like to address both these forms of integration.

There are three primary change factors causing this integration:
1. technology
2. geo-politics and
3. deregulation.

1. First, technology. In the computer industry, there are dramatic changes in scale:
- entire computer rooms collapse onto the desktop.
- CPU boards collapse to postage-stamp size and smaller.
- product lifecycles spin in what seems like nanoseconds.

In the telecom industry, technology changes challenge conventional thinking about the steps of progress: the fast advance of cellular makes it possible for countries to leapfrog the traditional path to create infrastructure.

2. Second, geo-politics.
- Largely because of telecommunications, the world is shrinking into a global village of interdependencies, especially economic.
- At the same time, nationalism is strong and all countries are striving to use economic development to enhance their world positions and internal standard of living.
- Free markets and privatization are current trends around the world, paving the way for greater opportunity and competition.

3. Third, deregulation. This trend is moving around the globe, from the Americas to Europe and the Pacific Rim. Last year alone, half-a-dozen countries deregulated their phone companies. Much of the telecom industry is expected to be deregulated by the year 2000.

Deregulation means competition on a global scale. It opens the way for companies from around the world to compete for a piece of the infrastructure pie. For example, Mexico's Telmex was sold to a consortium made up of Southwest Bell from the U.S., France Telecom, and Mexico's own Grupo Corso.

These factors - technology, geo-politics, and deregulation - also change the way we do business. The last example illustrates this. Companies from three countries must find a way to work together. So integration is both a technology issue, and a business issue.

On the technology side, all the markets Digital serves are demanding integration -- multivendor integration. Too much money has been invested -- trillions of dollars, in U.S. terms -- to justify any other approach. Integration is important in telecom principally because the networks that serve as backbones have grown rapidly in size and complexity. Worldwide infrastructures have been deployed over several years using a wide variety of technologies.

Now, especially because of increased competition, there is a need to improve service, reliability, and cost structures. One important way to achieve these improvements is by integrating disparate networks and systems into a unified entity that can be managed more successfully and efficiently.

This form of multivendor integration is critical to the telecom industry's development, but it is a tough nut to crack. We know. We're cracking it.

One result of our work with telecom providers is Digital's Enterprise Management Architecture for multivendor telecommunications networks. EMA utilizes industry and international standards to integrate network management and create an open development environment.

In fact, industry and international standards are central to our entire product strategy. This is because the direction of the industry -- the direction of all industries utilizing information technology -- dictates multivendor integration.

Our business focuses so strongly on multivendor integration that we launched The Open Advantage campaign to clarify within the marketplace the full scope of integration and openness. Judging from our growing experience in delivering multivendor integration, it takes more than UNIX or a few standard interfaces.

Multivendor integration takes a whole open business approach, which means providing open technology, but just as important, it also means your business practices and the service and support you provide.

I want to say a few words about this idea of an open business approach, because, although I am a marketing executive, this is more than just a marketing slogan. In fact, of all the profound change occurring in our industries, the idea of an open business approach is every bit as radical as the change in technology.

The reason I say "radical" stems from what I call the 3-C model, which says that at any given moment any number of companies will be your customers, your competitors, your collaborators. Not just one of these, but all three.

For example, IBM is a long-standing competitor of ours, but we also buy each other's products - so we are customers - and we serve together on many industry consortia as collaborators.

Many of you already are seeing this happen for your companies. The Mexican phone system example illustrates this again -- competing phone service providers are collaborators on an ongoing basis.

These really are profound changes. When you are used to competing hard against a company, it takes real effort and genuine motivation to collaborate. And it isn't easy to have a trusting relationship with a customer who is also your competitor. But this is what it is going to take to compete and serve in the world markets of the 1990s and beyond.

Many partnerships and alliances already exist, crossing international as well as industry borders:

- Motorola is providing cellular services to Indonesia.
- British Telecom is going to build and operate Thailand's telephone network.
- Taiwan and Bell Atlantic are exploring worldwide joint ventures.
- And Ameritech and Bell Atlantic purchased New Zealand Telecom.

These companies and governments are recognizing they are part of a global economy, with tremendous opportunities arising from changes in technology, geo-politics, and the regulatory environment.

What does it take to operate in a world that exists on a dichotomy between global and local concerns? It takes an organizational approach that is at once global and local. This translates into two further dichotomies -- the successful company of this decade must also be both big and small and decentralized yet disciplined.

What does this mean? - It means that customers and markets must be approached from a local perspective to deliver products and services that really do something for people in their own cultural context. At the same time, resource management must be global to find the very best design and manufacture, as examples, at the very lowest prices...wherever they exist.

- It means that a company must operate with the agility, entrepreneurism, and speed of a small company, but with the resources of a large company.
- It means that a global company must operate with the autonomy and customer focus of a decentralized company while exercising the corporate discipline of a hierarchical company.

The organization needed to compete in today's world is more than flexible -- it is elastic. Even its external borders change as it expands to include partnerships and alliances enabling it to be both large and small, global and local, decentralized yet disciplined.

The competitive structure for today and beyond is the dynamic organization. We've reached the stage where computers are not just essential to business operations, they are fundamental. Computer networking is the foundation for elastic, dynamic operations.

And the telecom industry ... together with the computer industry ... are the central providers of this very important capability.

Within an enterprise, networking is the means to balance between global and local, decentralized and hierarchical, large and small. Networking further serves to enable an enterprise to extend its borders to include partners, customers, researchers, and other important collaborators.

This is how we at Digital operate, as we have for many years. We sell what we live to our customers, helping them reshape their businesses. And together with our customers and our partners in telecom, we are helping to reshape human enterprise.

* For example, the integration of Germany is happening with the rapid deployment of a nationwide cellular phone system.
* The privatization of Czechoslovakia's economy will be helped by the creation of a network infrastructure.
* In medicine, online images of x-rays will enable doctors in rural areas to consult with specialists in cities, improving healthcare for large numbers of people.
* The government of South Australia plans to develop a state-wide information utility. Their partners in the program include both Digital and a competitor plus two competing telecom companies.

Its purpose is to integrate voice, data, and radio communications to serve government, the public, private business, and education.

South Australia intends to use this information utility to become more competitive in the world market and to help develop its own people and their standard of living.

Partnership is at the heart of the best changes taking place in our world today. The partnership of telecom and computers offers possibilities we might not have dreamed of...just a few years ago.

Together we can make the world a better place.

Asia Pacific Economic Cooperation (APEC): A Forum for the Future

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Abstract

Since its inception, the Asia Pacific Economic Cooperation (APEC) initiative has made great progress in telecommunications within a region which continues to change socially, technologically, and economically.

I. Introduction

It is a pleasure for me to come before the Pacific Telecommunications Council again to discuss the flourishing Asia-Pacific region and, in particular the Asia Pacific Economic Cooperation, commonly referred to as APEC. APEC is a relatively new economic and political framework in the Asia Pacific area intended to encourage increased economic cooperation and consultation, promote trade and investment flows, and help strengthen the multilateral trading system.

Today, I am glad to report that APEC is fulfilling its promise that I spoke of last year at PTC'91. Since its inception, the APEC initiative has made great progress within a region which continues to change socially, technologically, and economically. In particular, APEC is focussing on the regional telecommunications environment and is taking great steps to further telecommunications development.

II. APEC Background

APEC was established to deal with the effects of growing interdependence within the Pacific arena. A new mechanism for multilateral cooperation among the Asia-Pacific market-oriented economies clearly was needed. APEC is just the mechanism to fill that void. APEC began with 12 countries, and has become crucial in sustaining market-oriented growth, advancing global and regional trade liberalization, and meeting the new challenges of interdependence.

At the recent APEC Ministerial in November, the Ministers welcomed the participation of the People's Republic of China, Hong Kong and Taiwan in APEC. The participation of these three important economies will greatly contribute to economic growth and dynamism while increasing the potential for APEC to become a major political force in the Pacific arena.

Each of these three dynamic economies is undergoing different stages of economic restructuring to address the demands of a highly competitive, global marketplace. These changes are evident in telecommunications, where each economy is at a different stage of development. Hong Kong has a developed, open, competitive and liberalized environment. Taiwan plans to improve their telecommunications infrastructure through their six-year development plan, and is currently revising its telecommunications law to make more telecommunication services available through the introduction of a competitive environment. China is in its early stages of development in a wide variety of sectors, with telecommunications being central to its overall development process. By bringing unique experiences and perspectives to the table, these three economies will add tremendous value to the APEC process.

The Asia Pacific region has become America's largest trading partner. America's trans-Pacific commerce is now more than $300 billion in annual two-way trade - nearly one third larger than that across the Atlantic. The United States exports more to Thailand than to Ireland, more to Indonesia than to central and eastern Europe and more to Singapore than to Spain or Italy. Moreover, U.S firms have invested more than $61 billion in this area, with over $95 billion of Asian investments in the U.S.

Secretary Baker recently drew an analogy between the Pacific area in the 21st-century and the development of the American continent in the nineteenth-century. He said, "As the pattern of expansion and influence in the American West was determined by the location of telegraph and railroads, so the infrastructural links we are building across the Pacific in areas such as telecommunications and transportation will shape the economic and political character of the region and our ties to it."

This analogy is especially illustrative, because it exemplifies not only the exciting and rapid economic development in this area, but it emphasizes the importance of telecommunications in the overall development of any country or region.

Telecommunications has increasingly acquired major strategic political, economic, and social importance in the Asia Pacific area. It has become essential in most countries as a basis for improving economic infrastructural efficiency while expanding participation in global markets. For many firms in this region — both in manufacturing and service sectors — telecommunications has become a tool to enhance competitiveness by providing instant communications and a network of business relations.

The increasing globalization of markets, served from world-wide sources through new telecommunications infrastructures and services, will continue to reshape the fifteen participating APEC economies over the next decade.

For these reasons, the U.S. promoted the creation of the Working Group on Telecommunications and the second APEC Senior Officials Meeting in Singapore, May 1990, agreed to add telecommunications as its seventh project. The Working Group on Telecommunications was organized, with the U.S. as its shepherd, and held its first meeting in Singapore in July 1990.

This Working Group is the first broad, regional organization of governments from the Pacific Rim that brings government and private sector officials from both sides of the Pacific together to examine important telecommunications issues.

I would like to bring you up to date on APEC's recent accomplishments, the outcome of the APEC Ministerial in November, as well as APEC's activities in telecommunications.

III. APEC Ministerial

In the spirit of regional cooperation and economic growth, the APEC Ministers held productive discussions during the Seoul Ministerial on a wide range of topics including regional economic trends and issues, the Uruguay Round and trade liberalization, the APEC work program and future plans.

Although their primary focus was the successful conclusion of the Uruguay Round, one of the most important accomplishments was the declaration of APEC's principles and objectives. This Declaration gives APEC a distinct international agenda, states APEC's aims, and provides a firm foundation on which to base APEC's work for the years to come.

In their declaration, the APEC ministers recognized that the dynamic growth of economies brings growing economic interdependence, and that closer cooperation is needed to effectively utilize human and natural resources to attain sustainable economic growth and reduce economic disparities.

The APEC Ministers declared that the key objectives of APEC are to maintain the growth and development of the region, to enhance the benefits from increased economic interdependence, to develop and strengthen the open multilateral trading system, and to reduce barriers to trade and investment among APEC participants.

IV. Work Program

By taking a far-reaching and comprehensive approach in designing its progressive work program, APEC incorporates many different industries and facets of the economy. In fact, three additional work projects in fisheries, transportation, and tourism were recently adopted thereby expanding the work program to ten working groups.

These working groups are committed to open dialogue and consensus building taking into account the different stages of economic development among their members. They draw upon research, analysis and policy ideas from participating economies and other organizations such as the Association of South-East Asian Nations (ASEAN), the South Pacific Forum (SPF) Secretaries, and the Pacific Economic Cooperation Conference (PECC).

In addition, the private sector plays a critical role in APEC. APEC is not only a cooperative effort among its member countries, but it also requires close consultation between government and the private sector. The private sector is vital to the success of APEC, and is encouraged to participate.

In each of the ten areas, the APEC Working Groups seek:

1. to identify and define the region's common interests and project these interests in multilateral forums such as the GATT;
2. to promote consistency in policy making when appropriate by better understanding the policy concerns, interests and experiences of economic partners;
3. to develop practical programs of economic cooperation and to contribute to economic dynamism; and,
4. to promote the role of the private sector and the application of free market principles.

As an example of how the working groups are meeting these objectives, the Trade Promotion Working Group is establishing the APEC Electronic information Network (APEC ELIN) which connects Singapore's TDB Globalink with computer systems of each APEC member to exchange trade and industrial information. The Working Group on the Expansion of Investment and Technology Transfer in the Asia-Pacific Region has finalized a manual and inventory to assist in creating and managing technoparks.

The Regional Energy Cooperation Working Group collected energy supply and demand data from APEC members to form an energy database. They will study the potential use of clean coal technology and consider creating an APEC Coal Utilization Center for developing and introducing these technologies.
In the newly established Working Group on Fisheries, specific work plans are underway to identify fish stocks with management problems that require international cooperation; to cooperate in fish harvesting and post-harvesting technologies, and to cooperate in product marketing.

These are just a few of the examples. Activities that are equally as impressive are underway in the working groups that focus on transportation, trade and investment data, human resource development, investment and technology transfer, marine pollution, and telecommunications.

V. Working Group on Telecommunications

The Working Group on Telecommunications has taken a broad and comprehensive approach to promoting telecommunications that meets APEC's objectives of identifying common interests and policy concerns; promoting consistency in policy making; developing practical programs to contribute to economic dynamism; and, promoting the role of the private sector and the application of free market principles.

By working together to establish practical applications for telecommunications development, this working group is gaining a high level of understanding of the region's current technical environment. Under the leadership of Indonesia, Korea, and the U.S., the Working Group developed a detailed questionnaire for the APEC members to complete. The Working Group compiled data regarding the policy, regulatory, and network environments for each APEC participant. Korea kindly published the results for the November Ministerial.

This compilation provides a ready source for broadening our awareness of the telecommunications environment among APEC economies. It also provides a basis for developing specific recommendations for the Minsters' to consider when developing their telecommunications infrastructure and introducing new techologies. With this comprehensive survey, APEC will assess this year the rules regarding foreign investment in telecommunications, the standards setting process, and the relevant national laws and regulations. The Working Group plans to update these reports on an annual basis, thus providing a continual foundation for ministerial recommendations.

Japan, as one of the project rapporteurs for network development, proposed that the Working Group undertake a study on teleports in an effort to promote high quality international telecommunication networks in this region. This study identified issues that the Working Group should address when considering teleports as a means of enhancing the telecommunications infrastructure.

The Working Group held a seminar on teleports in May 1991 in cooperation with PECC to increase its awareness of teleports. This year APEC will continue to study teleports and its potential benefits. In particular, they will establish a better definition of teleports, design a work program, and get a better understanding of the needs of teleport users, management and financial issues, and regulatory effects.

Although the Working Group emphasizes network development, it has not lost sight of the human element of telecommunications. APEC acknowledges also that education is essential to the success of telecommunications operations across the board, not just in EDI. This Working Group is creating a manual entitled, "How to Approach Training Within A Telecommunication Organization" for meeting future human resource needs. The participants are

aggressively working on the manual, and they expect to present it this year at the September APEC Ministerial in Bangkok. Once the manual is completed, the Working Group will consider pilot testing the suggested recommendations and procedures in the manual by inviting telecommunications administrations to field test their recommendations.

The Working Group realizes also the far reaching impact of telecommunications applications, like Electronic Data Interchange, EDI, and has initiated a project to incorporate EDI into the regional trading arena.

Since effective international trade requires fast, efficient and accurate information to ensure the smooth flow of goods and services, the adoption of EDI throughout the Asia-Pacific region will generally enhance the facilitation of international trade within APEC countries and with other parts of the world. This EDI project could lead to the total electronic exchange of trade documents among APEC economies by the end of the decade.
Under this concept, APEC members are encouraged to actively develop international EDI applications in government to government, trade to government, and trade to trade transactions within their area. The U.S. is taking the lead in this effort, and we expect these plans will fall into place this year.

Initially the Working Group will develop pilot projects between interested members. However, the ultimate aim is to involve all APEC members. The results of the pilot projects will be shared among all members to demonstrate the operation and benefit of EDI.
To complement the implementation of the pilot projects, the Working Group accepted the EDI Council of Australia's proposal to develop a comprehensive education awareness program tailored to meet the specific needs of APEC members. This program will increase the awareness of EDI and its benefits throughout the region.

VI. Future of APEC

This year will be an important one in the evolution of APEC. Not only will APEC address key administrative issues such as the creation of a secretariat and the financing of projects, it will also work hard to integrate the newest members of the APEC family - China, Hong Kong, and Taiwan - into its process.

As for the future of telecommunications in APEC, I contend that as it broadens and continues to mature, telecommunications will retain its cornerstone position. This paramount position within APEC fulfills the promise of such groups as the PTC while making APEC unique among multifunctional, regional economic initiatives.

However, the importance of APEC is more than just the discrete projects that the working groups are pursuing or the individual economies that belong. It is, in fact, a true case where the sum of the parts is indeed greater than the whole. The mission of APEC is to be a truly cooperative effort that should produce real economic benefits for the entire region. Private sector is certainly welcome to join in this initiative as APEC embarks upon this year of implementation and cooperation.

Tuesday, January 14, 1992

Plenary

NOTES

INTELSAT SERVICES: COMMUNICATIONS FOR THE WORLD

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1. Abstract

INTELSAT serves the world with a comprehensive system of satellites and services. The quality and availability of INTELSAT services have increased, while costs have declined significantly. The burgeoning demand for global telecommunication services has taken up most of existing INTELSAT capacity, requiring additional capacity for future growth. The Pacific Ocean Region has unique service requirements and has experienced growth in all service areas. INTELSAT is planning how best to meet the needs of users in the Pacific Ocean Region and the other ocean regions, now and into the 21st century.

2. OVERVIEW OF THE INTELSAT SYSTEM

The INTELSAT system is a comprehensive and reliable global telecommunication network, with the largest commercial spacecraft fleet of any organization in the world. With the successful launch and deployment of the last two INTELSAT VI satellites in 1991, the INTELSAT system now has seventeen spacecraft in orbit available for service. This is the largest number of satellites in service in INTELSAT's history, and all are being utilized to meet the ever growing service requirements of INTELSAT's 180 user countries, territories, and dependencies.

The INTELSAT fleet today comprises four INTELSAT VI spacecraft and thirteen INTELSAT V and V-A spacecraft. Pacific Ocean Region users are served by four INTELSAT V/V-A satellites. Many Pacific users also utilize INTELSAT spacecraft in the Indian and Atlantic Ocean Regions, but for those Pacific nations with small amounts of traffic, the Pacific Ocean satellites are their primary source for international telecommunication services.

3. SCOPE AND PRICE OF SERVICES

Demand for INTELSAT services continues to grow in spite of competition from fiber optic cables and separate satellite systems. At the end of 1991, INTELSAT carried close to 125,000 full-time channels for voice and data and over 150 full-time leases for video, domestic, and business service applications. About one-third of our members use INTELSAT capacity to meet their domestic requirements, as well as their international requirements, and domestic lease services represent the largest percentage of full-time leases, system-wide, followed by international video leases. In addition, there has been dramatic interest and significant growth in transportable VSAT services.

INTELSAT's service priorities have been directed towards fostering network flexibility, both in space and on the ground, and developing less expensive and more efficient offerings to help members compete in an increasingly deregulated environment. INTELSAT has consistently offered more and better services, as reflected in the magnitude and scope of use of its resources, while steadily increasing system efficiency. In 1970, INTELSAT carried less than 5,000 full-time channels and no domestic service. Over the past ten years, full-time system use has more than doubled and full-time lease services have increased almost ten-fold. Throughout INTELSAT's history, it has consistently effected major reductions in the cost of service. For example, the cost of a voice channel has declined in real terms over a hundredfold since INTELSAT provided the world's first commercial telecommunication satellite voice channel, and a voice channel can now be obtained for as little as a U.S. dollar per day. This productivity has been achieved through technological innovation, the economies of scale made possible by ever increasing usage and system growth, and strategically pricing and marketing services. But INTELSAT has eschewed cross subsidy and expects to compete in price terms on a fair basis.

INTELSAT has aggressively pursued several initiatives over the past few years the cumulative impact of which has been extremely cost-effective communications. These initiatives include financial incentives for efficient use of space segment resources and conversion to digital operation and significant discounts for long-term commitments to system use. These kinds of initiatives will sustain INTELSAT in the years ahead and help the Organization to enhance its own and its users' competitive advantage, while attracting a growing level of traffic to the system.

4. ACCESSIBILITY

Aside from the price being right for INTELSAT service, the INTELSAT system has become easier to use. This goal has been accomplished in several ways. More options are available for users to acquire bulk capacity and configure it however they wish to best meet their needs. For example, INTELSAT now offers a transponder for unrestricted use service which permits users to acquire and use bulk capacity allotments for whatever international, regional, or domestic communications they wish. Ground network configurations are far more flexible and user specific, and INTELSAT's structure can accommodate a variety of access arrangements to meet individual country requirements as deregulation and privatization initiatives are undertaken.

4. 1 USE OF SMALL ANTENNAS

If ISDN was the buzzword of the 1980s, VSAT is the buzzword of the 1990s. As the INTELSAT space segment has evolved to more powerful and flexible operation, ground network options have also expanded. From the introduction of the INTELSAT Standard B antenna in 1976 to facilitate system access by users with smaller traffic requirements, INTELSAT earth station standards have evolved to keep pace with user requirements for more cost-effective and customer responsive network solutions. Today, given INTELSAT's many service options, the array of earth station choices is almost limitless. Earth station antenna sizes can range from the 15-18 meter size of a Standard A to under 2 meters for some business and video applications. Indeed, transportable VSAT services is one of INTELSAT's primary areas of growth, and as such, they are a top priority for INTELSAT.

INTELSAT has taken a number of steps over the past few years to extend the range of service options available with small antennas. Among these are INTELSAT's television broadcast services, INTELSAT Business Service, Intelnet, and even IDR service, where earth station antennas as small as 4.5 meters can be utilized. Domestic lease services also have the flexibility to accommodate any type of earth station configuration the user desires.

Satellite News Gathering (SNG) as a form of video broadcasting via transportable antennas is one of INTELSAT's fastest growing services and, indeed, of the international television business as a whole. Currently 21 Signatories have registered over 184 transportable earth stations for operation on the INTELSAT system to provide instant news coverage worldwide. SNG is now a day-to-day method of transmission within the INTELSAT system. This technique has become invaluable for coverage of world news and special events, such as the crisis in the Persian Gulf and the attempted Moscow coup in 1991. It was also used during the transmission of the Asian Games from the People's Republic of China in 1990 and will be used extensively during the upcoming Olympic Games in France and Spain in 1992.

Among INTELSAT's VSAT offerings, Intelnet is one of the most flexible. Intelnet networks use small, customer-premise earth stations, providing interactive service on terminals as small as 1.2 meters in diameter. Receive-only services are available on the smallest terminals that are on the market today. Because Intelnet can be used with such small earth stations, it can be implemented at very low cost and with considerable flexibility for expansion. One example of current applications of Intelnet is the Reuters News Service, which operates to over 1,000 receive-only terminals worldwide from its home office in London. Another example is Hong Kong International's World Broadcast Service which enables a subscriber to deliver data, pictures, facsimile and a teleprinter signal simultaneously and at different speeds.

Additional VSAT services are an important focus for INTELSAT in future service offerings and spacecraft designs. For example, INTELSAT is actively exploring and developing a C-band microterminal offering using very small, 0.5 to 1 meter terminals. Actions now underway include design and specification of both the hardware and the software for such a microterminal and related hub equipment. These terminals would be operated as part of a demand-assigned network of shared hubs providing two-way voice and data. A number of different applications could be supported by such an antenna, from thin-route telephony for rural and remote telecommunications to auxiliary voice channels for SNG operations. These C-band microterminals will be designed to operate with both global beam transponders for maximum worldwide coverage, as well as with any INTELSAT leased capacity to augment existing domestic or regional networks.

4. 2 MULTIPLE ACCESS

In addition to service and operational flexibility, INTELSAT's structure has sufficient flexibility to adapt to a changing environment where

privatization and deregulation promote multiple service providers. There is nothing in the INTELSAT Agreements which prevents INTELSAT from dealing with more than one carrier in a country. The Operating Agreement does impose specific requirements on a Signatory, but these do not prevent conclusion of arrangements that permit non-Signatory entities to deal directly with INTELSAT. A very wide variety of arrangements has been put in place to meet the diverse requirements of different member countries.

INTELSAT can accommodate the wishes of each country to fit the domestic regulatory regime of that country, particularly as those regimes change to reflect increasing deregulation, competition and privatization. For example, in the region Australia, New Zealand, and Korea have adopted multiple access arrangements, and other INTELSAT member countries are considering it. Activities which have already been accommodated under the Agreements with the approval of the Signatory concerned include: direct submission of earth station applications; direct discussion of services and tariffs; direct booking of leases and allotments; direct billing; direct payment; direct receipt of INTELSAT documents; attendance at INTELSAT meetings; and investment in INTELSAT through the Signatory's investment share. Any or all of these activities can be tailored to fit a member's particular domestic regulatory requirements.

5. FUTURE CAPACITY PLANS

With better quality, unmatched reliability, service flexibility, and decreasing costs, it should come as no surprise that demand for INTELSAT services is experiencing healthy growth system-wide. While overall traffic totals in the Pacific Ocean Region are not at the same levels as in the Atlantic and Indian Ocean Regions, Pacific basin service demand is outpacing growth in the other two regions in both the nearer and longer term. System-wide, INTELSAT anticipates a shift in demand patterns through the end of the century, as public switched network telephony traffic is divided between fiber optic cable and satellite and demand for video, domestic, and regional services grows. This trend is reflected in traffic forecasts for the Pacific Ocean Region which indicate that the greatest growth is anticipated in video, domestic, and business service applications. INTELSAT must take these factors, as well as varying requirements among ocean regions, into account when planning how best to meet future needs.

5. 1 PACIFIC OCEAN REGION GROWTH

As of the end of 1991, the four satellites serving the Pacific Ocean Region carried more than 20,000 full-time channels and 31 full-time leases, the majority of which were for video service. The most recent INTELSAT traffic projections, provided by Pacific Ocean Region users to INTELSAT's 1991 Global Traffic Meeting, indicate that Pacific Ocean traffic will experience very healthy growth through the remainder of the century. Pacific public switched telephony is forecast to experience modest growth over the next five years, a total of about nine percent between 1991 and 1995, and more significant growth over the next ten years, more than a third of 1991 totals, in spite of the proliferation of fiber optic cables in the Pacific. Anticipated growth in full-time leased services is far more impressive, particularly when one considers that the level of service in the Pacific in the near term is constrained by the lack of available capacity. The rate of growth in full-time leases is forecast to increase by more than two-thirds over the next five years and to more than double over the next ten years. Based on the traffic forecasts, video remains the lease service most in demand.

5. 2 OPPORTUNITIES FOR REGIONAL AND DOMESTIC NETWORKS

While video is an important service for the Pacific Ocean Region, regional, domestic, and business services are likely to become more important in the future, as additional capacity becomes available and as the region as a whole continues to experience a synergistic growth and economic development. Currently, several Pacific basin nations utilize INTELSAT capacity for domestic service, albeit primarily on Indian Ocean Region satellites at the moment: China, Japan, Malaysia, and Thailand. The Asia-Pacific Broadcasting Union has developed a regional video distribution network using INTELSAT's multiple origination/destination television service to facilitate news exchange among several Asia-Pacific nations.

Several Pacific Ocean nations are already using INTELSAT Business Service (IBS) to implement regional and international business networks. For example, our Malaysian Signatory, Syarikat Telekom Malaysia Berhad, is using IBS to link several electronics manufacturing companies with sites in Malaysia to their headquarters locations in the United States. Japan's Signatory, Kokusai Denshin Denwa Company Ltd., offers a high-speed business communications service know

as HI-BITLINK using IBS. Singapore's Signatory, Singapore Telecom, has an innovative digital videoconferencing service that it introduced in 1988, demand for which continues to increase.

The opportunity to enhance and extend domestic, business, and regional networks for Pacific basin users will increase when new capacity becomes available with deployment of the first INTELSAT VII spacecraft in 1993.

5. 3 LOCATIONS AND TIMING OF FUTURE INTELSAT SPACECRAFT

Current INTELSAT planning for the Pacific Ocean Region maintains a four-satellite configuration throughout the end of the century, two station-kept satellites at the 174°E and 177°E locations and two satellites in inclined orbit operation at the 180°E and 183°E locations. Current INTELSAT planning assumes launch and deployment of the first two INTELSAT VII satellites in the Pacific Ocean Region at the 174°E and the 177°E locations in fourth quarter 1993 and first quarter 1994.

The INTELSAT VII series was designed and developed for flexibility to meet the unique requirements of each ocean region, using the special requirements of the Pacific Ocean Region as the prototype. The INTELSAT VII spacecraft have several features that can be tailored for Pacific Ocean requirements. These include higher power at both C- and Ku-bands; wideband digital transmission capabilities, particularly at Ku-band to satisfy expanding business service needs; reconfigurable antenna coverage to respond to shifting traffic patterns; and improved connectivity.

INTELSAT VII satellites will provide more useable capacity than the INTELSAT V and V-A satellites they will replace. This is the result of the availability of more transponders (36 for the VIIs compared with 32 for the Vs), more bandwidth (2432 Mhz instead of 2250 MHz), and more power, combined with design features for more efficient use. Thus, each INTELSAT VII will have an average capacity of 18,000 simultaneous two-way telephone circuits, plus three TV channels, with the potential for up to 90,000 two-way circuits using digital circuit multiplication equipment. The e.i.r.p. levels of the INTELSAT VII satellites have been developed for compatibility with small earth station operation at both C- and Ku-band (33 dBW at C-band and an average of 46 dBW at Ku-band). These satellites will also provide more flexibility since they have steerable C-band antennas which can be adapted and configured for international and domestic requirements. They also have three Ku-band spot beams which are fully and independently steerable. A total of ten transponders is selectively assignable among the three spot beams to provide a flexibility not achievable previously on INTELSAT satellites.

A special session on the INTELSAT VII spacecraft has been organized and will be held during PTC for those interested in more details on the satellite's operation and capabilities.

6. CONCLUSION

Growth in service demand in the Pacific Ocean Region has given and will continue to give INTELSAT a special challenge. The diversity of needs requires a distinctive solution. INTELSAT has developed a dynamic and responsive solution for Pacific Ocean communications with INTELSAT VII satellites. System alternatives under consideration will extend and enhance the service flexibility required by Pacific Ocean users. INTELSAT, both now and in the future, will adapt to serve the world's changing telecommunication needs, reliably and effectively.

Pacific Technology Growth

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The growth in technology of undersea communications will provide capacities undreamed of only a decade ago. It will permit international communications services - voice, data, and image, that which we have not yet been able to imagine.

Technology has had a significant impact on communications all over the world. The Pacific basin, with its large area of water to cover, has benefited more than any other from the advancement of technology.

As each new cable was placed in service, the demand for communication services was increased. As each Administration placed these advances in their networks, our customers have taken advantage of the faster and larger capacity offered.

Changes in submarine cable technology has been even more significant than one would have believed in 1964.

In 1964 when the first submarine cable (HAW-2/TPC-1) was laid across the Pacific (AT&T - SD type), the capacity offered was 143 voice grade circuits between AT&T (then the only U.S. carrier) and its Pacific Basin partners.

Going from vacuum tube technology (AT&T SB Cable) to the transistor technology, the AT&T SD Cable was out in the forefront of submarine cable technology. The latest TPC-3 and TPC-4 Cables use fiber and light rather than copper and electrical signals as a transmission medium.

By the year 1974, total cable capacity was around 1,000 voice grade circuits.

The introduction and provisioning of digital submarine fiber optic cable facilities have been rapidly expanding in the Pacific. Starting with the first digital fiber optic cable, HAW-4/TPC-3 in April 1989, additional fiber optic cables have already been installed (G-P-T, H-J-K, HONTAI-2 NPC) and additional fiber optic cables are planned. On an average, approximately 13,000 Km of submarine cable is being constructed in the Pacific every year.

Although ocean spanning fiberguide cables are not yet three years old, undersea digital technology already directly connects over 20 countries in the Western Pacific, North America and Europe, and additional systems currently planned will nearly double that number. New optical amplifier technology now under development for application in the middle of this decade will provide bandwidths undreamed of only a decade ago.

The first generation of high speed digital fiberguide systems began providing service across the Atlantic as TAT-8 in 1988 and the Pacific as Hawaii-4/TPC-3 in 1989. These 280 Megabits per second 1.3 micron systems gave digital connectivity over cable between Japan, the United States, France, and the United Kingdom. They provide capacity of 40,000 voice circuits, much greater than that of the last generation of coaxial systems with cable size and repeater spacing approaching that of the earliest coaxial designs. The transmission performance, such as errored seconds, by far exceed owners' specifications. The transmission performance is rated by the end user as excellent.

Systems currently under manufacture and installation have continued the rapid technology advance. These second generation systems operate at a 1.5 micron wavelength, the so-called third transmission window. Lasers which emit only a single frequency of light are used instead of the multi-frequency lasers of the first generation systems. Repeater spacings are now up to 150 kilometers. The transmission rate is 560 Megabits per second and total capacity is up to 120,000 voice circuits. This technology will be employed to extend digital connectivity over cable to Australia, New Zealand, Egypt, India and other nations. It will also be used in TAT-9, TAT-10, TAT-11, Hawaii-5 and TPC-4 to supplement the initial ocean spanning cables. It is expected that the number of kilometers of second generation systems will far exceed that of the first. Soon hardly a corner of the earth will lack the benefits of the quality digital connectivity provided by cable.

The latest planned submarine fiber optic cable technology involves AT&T/KDD Bell Laboratories Optical Amplifiers rather than Regenerative Repeaters to amplify the digital signals. This "OA" (optical amplifier) technology allows for significant increases in cable capacity and is the first time that a cable's capacity will far exceed the capacity of a satellite.

Optical amplifiers will lead to repeaters that are significantly less complex than those required for the first and second generation undersea systems. The transmission path in the repeater will consist only of the erbium doped fiber and some optical filters and couplers. The critical optical component is the laser pump. This device, however, will need to operate only as a continuous source of photons in contrast to the laser transmitter in the

regenerative systems where the spectral characteristics of the light are critical. Consequently, achieving suitable reliability for the laser in an amplifier system should be a less challenging task.

Already various laboratories have demonstrated transmission of at least 10 Gigabits per second over distances greater than 10,000 kilometers. These experiments use a recirculating loop in which an optical pulse stream is launched into a closed loop of several fiber spans and amplifiers. The pulses propagate many times around this closed configuration to simulate ocean spanning distances. Also, direct non-loop experiments have been successfully performed at Gigabit rates over a few thousand kilometers and it is expected that a direct experiment of 9,000 kilometers will be performed within a few months. Initial application of optical amplifier based third generation systems in the Pacific and the Atlantic is planned for 1995.

Locations currently served by digital fiber optics cables include:

Hawaii	Hong Kong
Guam	Japan
Korea	Philippines
Taiwan	United States

New digital cables are bing added each year, such that by the end of 1994, eight new locations will have joined the growing Pacific network.

Australia	Malaysia
Brunei	New Zealand
China	Singapore
Indonesia	Thailand

Some of the Locations will have more than one cable (Path) terminating on their shores, thereby being able to offer diversity to you, the customer. These new countries are:

Australia	Malaysia	Thailand
Japan	Taiwan	Indonesia
Singapore	Hong Kong	Philippines
Brunei	New Zealand	USA

Restoration of existing cables and cables planned for service in the early 1990s have depended on using a combination of satellite capacity and unactivated capacity on the most recently installed cable. There are several problems with this arrangement:

Satellite restoration provides rather small capacity as compared with the capacity of the TPC-5 CABLE NETWORK and requires dedicated Earth Station equipments/access facilities.

Cable restoration capacity is constantly decreasing as more DS-3 facilities are activated for service.

Cable on cable restoration between separate cable systems requires complex interconnecting arrangements and agreement between the Management Committees of the involved cable systems and, in some cases, requires dedicated terrestrial equipment and access facilities.

Starting in 1994 and continuing through 1996, a new series of Optical Amplified, high capacity digital fiber optic cables will be installed in a "LOOP" connecting the western United States to the Pacific community, via Hawaii-Guam to Japan and back to the United States.

Known as the TPC-5 NETWORK, this new system will provide much needed additional trans Pacific capacity that will feature diversity, reliability and a dedicated restoration fiber pair. This dedicated fiber pair will be used for extremely rapid fiber-to-fiber restoration in the event of a cable failure.

The capacity available on the TPC-5 NETWORK will be 120,480 64Kb circuits.

As I stated earlier, with the 1964 introduction of the TPC-1 Cable, there were 143 circuits available. The TPC-5 Network will offer a band width having the capacity of offering 120,480 64Kb circuits. We are proud of AT&T and KDD Laboratories for developing the Optical Amplifier. Thereby giving us the opportunity to offer you the type of capacity that enables you to meet your varied and constantly increasing communication needs.

Telecommunications entities internal and external to the Pacific have made enormous investments to provide all of these.

By year end 1998, the International Common Carrier will have invested in excess of four billion dollars in Pacific Basin Submarine Fiber Optic Cable Systems to meet the needs of our customers.

This new technology will be one more step in the long and glorious history of undersea communications, digital transmission and photonics. It will provide capacities undreamed of only a decade ago at a cost also undreamed of only ten years ago. It will permit international communications services - voice, data and image - that we have not yet been able to imagine.

TELECOMMUNICATIONS IN DEVELOPING COUNTRIES - BENEFITING FROM NEW TECHNOLOGIES

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1. ABSTRACT

Recent advances in technology have brought down considerably the cost of transmission and switching hardware. The emerging intelligent network technology provides further possibilities of reduction in investment for the new expanding networks. A judicious application can result in very significant cost savings.

2. INTRODUCTION

Recent advances in solid state electronics, digital signal processing and software development and management techniques has significantly brought down the cost of transmission and switching components of a telecommunication network. Although there is considerable scope for reducing the average investment for providing one telephone line, in practice there is no significant impact as yet. One of the reasons for this is the continuation of the traditiona. ways in which telecommunication plans get implemented. Our studies indicate that by adopting a new strategy, it may be possible to reduce the level of investment per line from 30% to 50% of the present levels. In order to be able to achieve this, a three pronged approach is required. Technology, topology and operations are three most important factors. A set of digital switching and transmission products well matched to the countries' needs is perhaps the single most important factor in effecting economy. The next important factor is the network topology that will take into account the powerful signalling and information networking capabilities that are now provided by even the smallest switches. Use of remote maintenance unattended operation, graphics-oriented network management and control tools help further in bringing down the overall investment.

3. TECHNOLOGY OPTIONS

Following are the technology components that are of immediate relevance:

- Optical fibres
- Digital microwave
- Digital crossconnects
- Digital/cellular radio
- ISDN and CCS7 signalling
- Digital signal processing
- VLSI components
- Speech processing
- Graphics
- Software tools
- Intelligent network technology

3.1 SOME APPLICATION EXAMPLES

3.1.1 TRANSMISSION

Optical fibres, and to a lesser degree, digital microwave provide a cost effective solution for high bandwidth long distance interconnections. Analog and digital radio in VHF and UHF band, on the other hand is excellent for short range requirements in both urban and rural areas. Less expensive multiple access radio systems are expected in the near future.

3.1.2 SWITCHING

The cost of switching has been dropping significantly over the past several years. The new systems provide higher call handling capacity, digital connectivity and, above all, transit capability which simplifies networking in the rural/low density areas. Further savings are possible by improved integration of radio transmission with the switch, eliminating expensive line circuit components. Digital cross connect systems with network management control are very important for

improved utilization of resources. This helps in adapting the network to the traffic needs in a dynamic manner.

3.1.3 ISDN/CCS7

The advantages of the new technology are obvious. However the full potential of CCS7 signalling system remains to be exploited. This provides a powerful messaging capability that goes far beyond handling the signalling function. It can be utilized for network management and control, introduction of novel services and help in setting up virtual private networks. CCS7 will be the key element in all future networks. Adding further networking and processing capability (e.g. transaction processing) it leads to the powerful and versatile intelligent network technology.

3.1.4 NETWORK TOPOLOGY

One has to take a fresh look at the way in which new networks are designed. Traditional methods based on thumb rules may not be valid in the new context. Integration of switching with transmission and the availability of powerful messaging capability permits us to implement networks in which the switches are placed closer to the traffic, thus reducing the cost of switching as well as transmission. Also remote operation and maintenance can be introduced without much difficulty.

3.1.5 POWER REQUIREMENTS

This aspect is important especially in the developing countries and the rural areas where the main power is either very irregular or totally absent. Very low power components based on complementary metal oxide silicon are now available in wider range and higher complexity. This makes it possible to have very low power systems which can be powered optionally by solar cells. An area that seems to have been neglected is the solar cooling (refrigeration). Development of this technology will provide us a reliable low cost cooling solution for desert areas. A number of solutions based on passive and active (absorption) techniques are available but they are yet to be applied in large scale for telecommunication purposes.

3.1.6 UPGRADATION OF OLDER NETWORKS

One of the serious problems in modernization is the upgradation of older networks. The wide gap between the facilities provided by the new systems and the older systems forces us to consider full replacement. However this is not necessary in all the cases. If there is a reasonably reliable and efficient basic POTS network, then the more advanced facilities such as call detail record, subscriber "controlled" long distance calling, automated operation and maintenance, network management and control can be introduced by an intelligent add-on interface. Such an interface can be implemented through a microprocessor based signalling handling unit and a set of computers (data bases) interconnected by a packet network. Such intelligent add-ons can also be used for implementing 800 and 900 types of services, credit card calling, etc.

4. INTELLIGENT NETWORK TECHNOLOGY

As the customer needs become more and more complex and varied, their implementation needs more efficient ways of handling messaging and data base engineering and management. The focus shifts from the traditional transmission, switching and terminals to signalling and networking. Through this is evolving the new intelligent network technology. This is expected to have significant impact on the new networks and facilities.

Networks that are termed "intelligent" are still in the process of evolution. The first stage is the IN/I. In this phase, essentially the "intelligence" is "added on" to the old networks. Existing network expansion based on relatively dumb switches (the service switching point, SSP) interacting with an intelligent centralized data base (the service control point SCP) which also contains several service specific application software and customer records. This permits introduction of new services at the highest level. The inherent limitation of this approach is its service dependent software; each service requires a new software package that in turn requires considerable effort and time. However it does have an advantage in its ability to upgrade old networks for new services.

The next stage of advancement is the IN/2 network. This aims at providing a fully service/application independent architecture to meet a wide range of new, expanding services with an easy method of service creation and management. Implementation of this needs more intelligence at the local switches and several new hardware and software elements at each node. There is a standardized service creation environment which allows new services to be defined and implemented without reference to the specific network elements. The facilities also permit quick and easy way of protyping new services. All this would need significant upgradation of local exchanges which, without network expansion, may not be cost effective.

IN/I+ is an intermediate solution based essentially on existing hardware and software. Here the intelligence is not fully distributed throughout the network but at certain specific points which standard functional messages (service independent) to the local switch.

4.1 THE PRIVATE VIRTUAL NETWORK (PVN)

Among the several facilities that are provided by the intelligent IN, the ability to create private virtual networks (PVN) is very important. PVN will permit implementation a service with which a business can tailor its own network based on the resources of the public network with IN capability. The user pays for the resources and the network guarantees that the resources will be there when needed without actually allocating a physical resource permanently to a specific user. A network management system is also available to the user along with the PVN.

These PVNs allow the user to implement Value Added Networks (VANs) in a very cost effective way. It is not necessary to make any large investments in permanent physical resources. By having a large IN as a backbone, the public network is able to benefit from the economies of scale and the wide bandwidth provided by the optical fibres.

5. IMPLEMENTATION

Networks of countries such as India, China, Brazil, Indonesia, Chile, Peru and Mexico that are presently in a state of rapid expansion can benefit from the new technologies. As a specific example, the Indian network is expected to expand from the present level of about 5 million lines to over 20 million lines in the next 10 years. A recent study indicates that by adopting only a few of the techniques suggested, the cost per line can be expected to come down by as much as 40%. The most important requirements are:

- Establishing a very high capacity [560 Mbps/140 Mbps/34 Mbps] digital backbone network that will meet the immediate and future needs. This will be based mainly on optical fibres and, to a lesser extent, on digital microwave for interconnecting the main, primary and secondary centres.

- All centres to have digital cross-connect systems (1000 to 100,000 ports) for providing better connectivity, alternate routing and fault tolerance. Facilities include digital patch-panel, 30 channel switching capability and network monitoring.

- Cellular Subset and/or 10/30 channel digital rural radio to be used in rural areas.

- Apart from large switches required for metropolitan areas, small switches (50-500 ports) and medium switches (500-5000 ports) are required in very large numbers. Small switches serving rural areas must be capable of operating without airconditioning and with irregular power supply. All switches will have facilities for handling transit traffic, centralized maintenance and operation.

- Rural radio with 10 channel (ITU) standard and 30 channel (CEPT) standard.

- There is considerable scope for novel cost effective solutions such as integration of the rural switch with multiple access radio for rural application.

- An open ended digital connectivity to facilitate introduction of ISDN-type services in the future.

- Evaluation of intelligent network technology immediately for implement- ing private networks, introduction of new services and facilities and improvement in resource utilization. Smaller

countries can cooperatively share a large network through this technology. It is estimated that savings in the range of 20% are possible.

6. CONCLUDING REMARKS

A number of technologies that have direct impact on telecommunication facilities and cost have been perfected and commericalized in the recent past. Apart from basic hardware and software components, concepts from new emerging intelligent networks are likely to have beneficial impact on the investment and cost of providing high grade communication facilities. Based on preliminary studies, the savings could be in the range of 30-50%.

It is to be noted that the intelligent network technology will provide advanced facilities even without the full implementation of ISDN. Only large scale implementation of CCS7 signalling is required.

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Globalization of Training in NEC

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ABSTRACT

To meet the corporate strategy of globalizing every aspects of NEC Group's activities, education and training function is also in the same process. Various types of education and training are important aspects of this strategy. This paper highlights the training for the technical transfer relevant to NEC products and how globalization is to be driven in this particular area. To help you understand that NEC devotes itself to education and training activities, overview is made to cover employee education and customer training prior to the main subject.

1. INTRODUCTION

1.1 CORPORATE PROFILE OF NEC

(Fig.1)

NEC Corporation, founded in 1899, is a leading international supplier of electronics products that comprise primarily telecommunications systems and equipment, computers and industrial electronic systems, and electron devices. All of the Company's activities are focussed on its synergistic business concept of "C&C", the integration of computers and communications.

In Japan, NEC operates through a network of sixty consolidated subsidiaries, sixty-two plants, and more than three hundred sales offices. Overseas, the Company's seventy affiliates and twenty-three liaison offices cover marketing, service, and research and development activities. NEC as a group consists of about two hundred affiliates in forty-four countries.

The number of employees in Japan and abroad is about one hundred twenty thousand on a consolidated basis and about one hundred eighty thousand people worldwide are working for the entire NEC group of companies. Its products are used in one hundred forty-nine countries in the world. The consolidated turnover in the fiscal year ended March 1991 amounted to twenty-six billion U.S. dollars. NEC Corporation is headed by Mr. Kenzo Nakamura, Chairman of the Board and Dr. Tadahiro Sekimoto, President.

(Fig.2)

This figure depicts the history of innovation in the areas of communications, computers and electron devices and how the computer technology and communication technology have merged to build a compound technology that we call "C&C" supported by device technology.

(Fig.3)

Among the total sales of twenty-six billion U.S. dollars, international business occupies the portion of twenty-three percent. This value gives quite a significant impact to the total corporate management.

(Fig.4)

This graph shows sales by product area classified to communication systems and equipment, computer and industrial electronics, electron devices and others. NEC started its business in the telecommunication area, but nowadays the largest sales comes from computer related area which reaches almost half of its total sales.

(Fig.5)

Let's take a look at the international business. You will find that unlike the story of the total sales, the largest portion is still occupied by NEC's traditional area i.e. communication systems and equipment. Here I would like to draw your attention to how NEC is devoted to contribute to the advancement of telecommunication systems in the world.

1.2 EDUCATION AND TRAINING SYSTEM OF NEC

(Fig.6)

Since you are now somewhat informed of NEC's sizable human resources as well as variety of businesses, you will also appreciate that NEC has been making a significant investment and a lot of effort to establish a well-organized system for employee education and customer training.

1.2.1 Employee Education

1.2.1.1 Orientation for New Employees

When school graduates join NEC in Japan, they participate in orientation courses off-the-job, for the initial two months, before their specific job assignment is clarified. Even after their job is defined, they will participate further in new employee courses during the first year. This new employee education is planned and executed by Personnel Relations Division.

1.2.1.2 Professional Knowledge and Skills Development

Many organizations are involved in developing professional knowledge and skills required for employees. Let me introduce a few examples of the institutions specialized in technical education.

Institute of Technology Education

Under the current rapidly changing technological environment, many engineers, having a Bachelor of Science Degree, find themselves short of the knowledge and skills that are necessary to handle their job within a couple of years time, after joining NEC. To give them continuing engineering education, the Institute of Technology Education was set up within NEC Corporation in 1979. Courses corresponding to a Master Course and Doctor Course in Universities are provided to the engineers working for NEC group of companies. The number of graduates from this Institute in the last fiscal year reached two thousand six hundred seventy. The number of graduates skyroketted during the last couple of years caused by increasing demand among engineers and thanks to the remote education system, using satellite to be touched upon later.

NEC Technical College

To cope with the corporate strategy of supplying products designed with C&C technologies, it is essential to nurture technicians having adequate capabilities to operate plants where machinery and manufacturing facilities are constantly being upgraded by new applications in electronics and computers. To meet this objective, NEC founded NEC Technical College in 1986 as the first intra-corporate college in Japan approved by the Ministry of Labor.

This college provides two year initial training for high school graduates who wish to work for the NEC group of companies. The curriculum covers the fundamentals of mechanics, electronics and software through lectures and practical training. Moreover, upgrading training for the already skilled workers in NEC is provided to enhance their knowledge in electronics and computer software.

Computer-aided instruction and remote education by satellite are frequently used. The number of graduates from the initial training course is about one hundred twenty per year. Participants in upgrading courses have exceeded one thousand in the last fiscal year, thanks again to satellite education.

1.2.1.3 Managerial Skills Development

To enhance managerial and administrative skills of staff members, NEC set up an affiliate NEC Institute of Management, Ltd., in 1983. This institute undertakes the educational function of the Corporate Human Resources Group and provides a wide variety of courses for the staff members of NEC group of companies such as:

- Management education differentiated by the managerial level in the hierarchy of the organization, ranging from assistant managers to board members

- Self development courses covering a wide variety of knowledge and skills that are required for fulfilling individual jobs

- International business education for the employee involved in international business including overseas transferees and employees of overseas affiliates or offices. Courses cover managerial, administrative, cross-cultural and language skills training.

- Production systems innovators education to develop strategic industrial engineers and upgrade the ability of employees to plan and implement innovative production strategies to enhance the production capabilities

(Fig.7)

- Courses using two-way audio-visual remote education systems via satellite named NESPAC which has been used in NEC's intra-corporate education since 1987. Currently NEC has facilities having this capacity at eleven locations.

(Fig.8)

Marketing and production courses are provided under the course name of Satellite Business College. Courses using low cost one-way visual two-way audio satellite remote education systems named NESPAC-TV that are installed at more than one hundred fifty offices or plants as of the end of October, 1991. This has tremendously expanded the number of participants and thereby contributed to reducing the cost of education. NESPAC and NESPAC-TV are now used as an educational infra-structure by many course providers in NEC as previously exemplified in the section covering the Institute of Technology Education and NEC Technical College.

The number of participants in the courses provided by this institute reached more than twenty-four thousand employees in the last fiscal year. Educational opportunities made available by NESPAC and NESPAC-TV are estimated to be over half million student-days.

1.2.2 Customer Training

1.2.2.1 Domestic Customers

Training for domestic end-users who purchase large systems directly from NEC is mainly made by NEC's product groups. Training for customers on the equipment supplied through distributors or dealers is made by them with adequate and timely support from NEC. In this way, it is very important for NEC to train the trainers of distributors or dealers. This training is provided by the Dealer Support Division of the domestic sales group with the assistance of the product group.

1.2.2.2 Overseas Customers

NEC's overseas affiliates undertake the training for the equipment or systems supplied by them to their customers. NEC's distributors or dealers undertake the training for the equipment supplied by them to their customers with the assistance of NEC's overseas affiliates whenever necessary. In these cases where end-users purchase products directly from NEC Corporation in Japan, training for such customers is made by one of the NEC's wholly-owned subsidiaries named NEC International Training, Ltd. When NEC's overseas affiliates, distributors or dealers need to be trained to provide training for their customers, NEC International Training, Ltd., also undertakes such training. In the following part, I wish to refer to the main subject of my presentation today and focus on NEC's approach to overseas customer training.

2. TRAINING FOR OVERSEAS CUSTOMERS

2.1 ORGANIZATION

2.1.1 NEC International Training, Ltd.

(Fig.9)

NEC International Training, Ltd., or NECITR in abbreviated form, was established in July, 1990, as one of the subsidiary companies of NEC Corporation. By consolidating all of the resources for training, available within NEC group, this unique company was organized to provide a higher level of efficient training to NEC's overseas customers, dealers and employees of overseas subsidiary companies.
Since its establishment, NECITR has been trying to plan and implement the training courses both in Japan and overseas, in order to transfer the knowledge and understanding of the technology of NEC products. We are quite confident that such technology transfer will help those one hundred forty-nine countries to which NEC has supplied its products to progress economically towards the twenty first century.
Our Head Office is located in Tokyo.
(Picture)
As for training facilities, we have three training centers and one hotel-type accommodation.
The first training center is located at the same building as our Head Office in Tokyo.
It has more than ten classrooms of various size, two equipment rooms, one CBT room for the training of central office switching equipment and computer software.
The second center is called Tamagawa Training Center and located in Kawasaki city. (Picture) It has seven classrooms and three equipment rooms for the training of transmission equipment such as Fiber Optics Transmission Equipment and Multiplexer.
The third one is called Yokohama Training Center and located in Yokohama city. (Picture) It has five classrooms and three equipment rooms for the training of Radio equipment such as Microwave, Satellite communication equipment, and Cellular Mobile Telephone system.

As an accommodation for trainees from overseas, we have hotel-type accommodation called Takilio House. (Picture) It has ninety-eight single rooms, two twin bedrooms, one Japanese style room, lobby, lounge, dining room, two kitchens for one's own cooking, KARAOKE room, etc.

The number of employee of NECITR is about one hundred thirty.
Major services we provide, are the planning and implementation of technical training both in Japan and overseas, organizing various seminars both in Japan and overseas, and management and operation of the accommodation for the trainees.

Now, I will explain about major training activities of NECITR.

2.1.2 Training in Japan

(Fig.10)

This shows the number of trainees who came to Japan in the last twenty-five years. As you see here, the number has been increasing steadily. In 1991, we are receiving an average of one hundred fifty trainees every month from various countries of the world.

(Fig.11)

This shows the percentage of the trainees by subject for the fiscal year 1990. Trainees for Microwave and Satellites form the biggest portion followed by Switching, Transmission and Information Processing.

(Fig.12)

This shows the percentage of the trainees by region. Trainees from Asia form sixty-one percent of the total, and followed by Middle East, Europe, Africa and North America.

2.1.3 On-Site Training

(Fig.13)

The number of trainees who were trained by our instructors at the customer's premises for the last six years is shown here.

(Fig.14)

The percentage of the trainees by subject for the fiscal year 1990 are indicated here. Trainees for Switching form twenty-four percent, followed by Microwave & Satellite, Transmission and Information Processing.

(Fig.15)

The percentage of the trainees by region highlights the fact that trainees from Asia form the biggest portion and form almost half of the total. Then, Latin America thirty-nine percent, followed by North America and Europe.

2.1.4 Organizing Seminars

NECITR organizes various seminars both in Japan and overseas. In Japan, we organize at least two two-week seminars every year. The theme of the current seminar is "Network Planning".
In addition to this, we send several experts to overseas locations to organize seminars on C&C Technology. For these we invite officers, engineers, professors, students from the government, carriers, universities, and others of the specific country.

2.1.5 Other Activities

(Fig.16)

This shows other activities of NECITR for trainees.

We provide the product training course to the sales engineers of NEC's overseas subsidiary companies. Also, we provide the training course to our own instructors so that they continue to strengthen their teaching skills. We provide trainees with Japanese language course or basic technology course as an option. They can take these courses in the evening after they finish the technical training course if they wish.
Further, we arrange factory tours or study tours for trainees so that they can get more knowledge about NEC and Japan. (Picture)
As a special gesture to the trainees, we offer them an opportunity to visit Japanese family to experience a typical Japanese style of life. (Picture)

2.2 GLOBALIZATION OF TRAINING

As one of the multi-national companies, NEC's operations are worldwide.

(Fig.17)

As shown here, NEC has twenty-six manufacturing affiliates in fifteen countries, forty-four marketing & service affiliates in twenty-three countries, and twenty-three liaison offices in twenty-one countries. In total, ninety-three operations in forty-three countries.
This means that NEC has been globalizing its operations not only in manufacturing but also in marketing, engineering and service. Of equal importance has been the expansion in Research and Development. Now, I would like to explain how NEC is globalizing in the field of training.

2.2.1 Instructor

NECITR has forty-five full-time instructors within its organization. Among them, we have twelve non-Japanese instructors and their nationalities vary as follows:

Guatemala	1
Mexico	2
Philippines	1
Singapore	2
Sri Lanka	4
U.S.A.	2

They are experts in each field of technology and can instruct either in English or Spanish or Chinese.

2.2.2 Global Sharing System for Instructors

As already shown, NEC has many subsidiary companies overseas. Most of them have their own training department and training facilities for their customers or dealers. The instructors of these companies have enough expertise to teach their customers or dealers. NEC provides the necessary technical-transfer to these instructors. From time to time, we organize a special course to retrain these instructors in Japan.
Therefore, these instructors maintain the same level of expertise in each of their technical field as Japanese instructors.

(Fig.18)

On the other hand, as shown here the training demand varies up and down based upon the month of the year. We have two peak times, that is, spring and autumn, and two low times, that is, summer and winter. The gap between the peak time and low time is quite large. Because of this, it is very difficult to adjust the schedule of the instructors.
If we maintain the number of instructors based upon the peak time, then we will not be able to fully utilize their talents during the low periods.
On the contrary, if we maintain the number based upon the lower periods, we may face a severe shortage of instructor at the peak time. With this in mind, it is more efficient and economical to share the instructors on global basis. The peak training time of each country is different country by country.

(Fig.19)

This identifies the key aspects of the actual operation of our Global Sharing System for Instructors.
As you see here, we are sharing the instructors among NECITR and other NEC's overseas companies. For example, we ask an instructor in New Zealand to go to Iran to offer instruction to one of the customers in Iran. Or we ask an instructor in Malaysia to come to Tokyo to instruct a group of trainees from overseas.
This system helps us to cope with the up and down of training demand in each country. It also gives the instructors a broader opportunity and incentive to go to a foreign country and gain additional experience.
Moreover, from the viewpoint of the limited human resources, this system is the most efficient way of utilizing our human resources on the global basis.

Next, I would like to introduce another example of globalization in the area of training. In the U.S.A., one of the subsidiary companies of NEC participates in the overseas telecommunication projects together with the U.S.A. firms. In accordance with the contracts, NEC's subsidiary company can send the instructors to overseas customers, such as Philippines, Mexico, Korea and Canada. Or NEC's subsidiary company can also receive the trainees from overseas at their training centers.

2.2.3 Global Sharing for Course Material Development

In addition to the Global Sharing System for Instructors, we share the development works for course materials, such as training text, CBT modules, etc., among NEC's overseas subsidiary companies. This also helps to utilize the limited human resources to the fullest extent.

3. CONCLUSION

This paper covers briefly the global activities of NEC in the field of customer training. NEC views the customer training as an extremely important corporate activity-no less than R&D, manufacturing or marketing. NEC designs and manufactures its products to the highest standards of quality and reliability.
However, it is the customer's operation and maintenance staff that really puts our products to the test. It is in those areas of placing the equipment into service and being able to operate and maintain it over many years that the important elements of training are most important.
Therefore, we try to always stand behind the products and customers by providing the best training using the latest technology of teaching as well as the best quality of course materials. This, after all, is the meaning of our corporate philosophy: "NEC strives through C&C to help advance societies worldwide toward deepened mutual understanding and the fulfillment of human potential."

NEC

Corporate Outline

- Established July 17, 1899
- Net Sales (US$26.2Billion)
- Net Income (US$ 0.4Billion)
- Capital Stock (US$ 1.3Billion)
- Employees 117,994

<Net Sales>

<Top Management>

Kenzo Nakamura
Chairman

Tadahiro Sekimoto
President

Fig. 1

NEC

The Expanding World of "C&C"

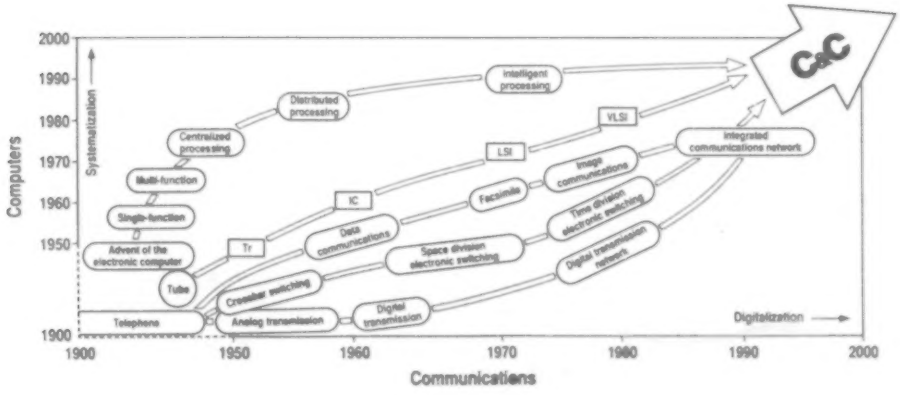


Fig. 2

NEC

Sales

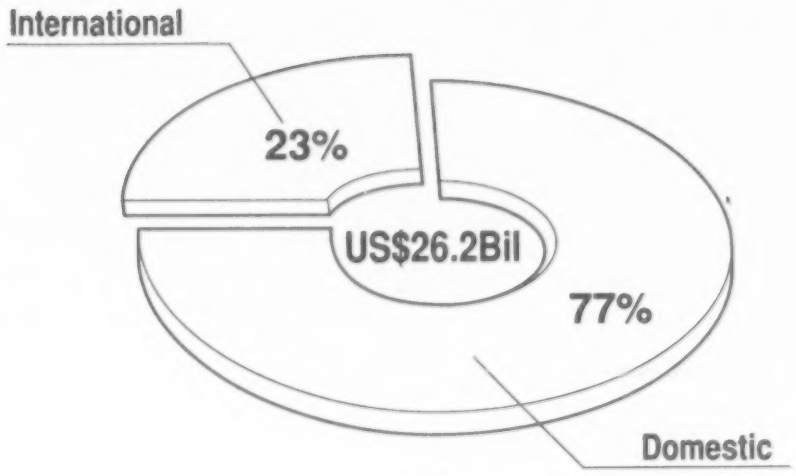


Fig. 3

NEC

Sales by Product

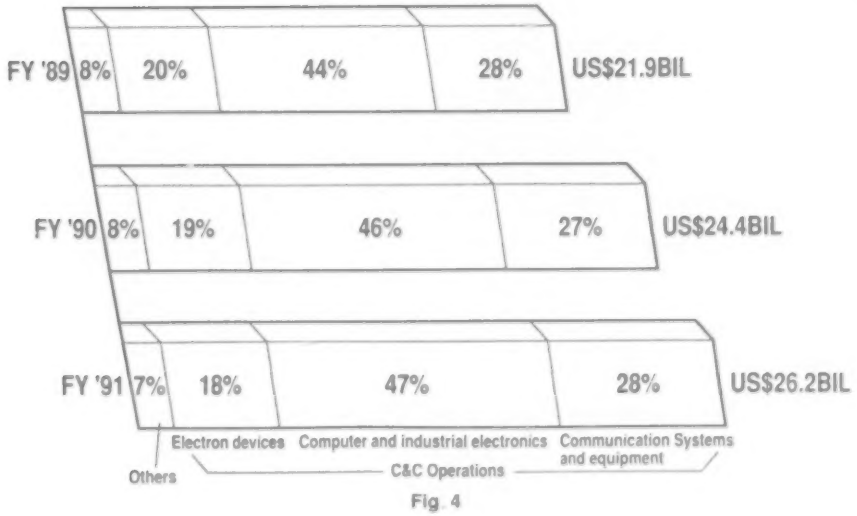

FY '89 8% 20% 44% 28% US$21.9BIL
FY '90 8% 19% 46% 27% US$24.4BIL
FY '91 7% 18% 47% 28% US$26.2BIL
Electron devices
Computer and industrial electronics
Communication Systems and equipment
Others
C&C Operations

Fig. 4

NEC

International Sales by Product

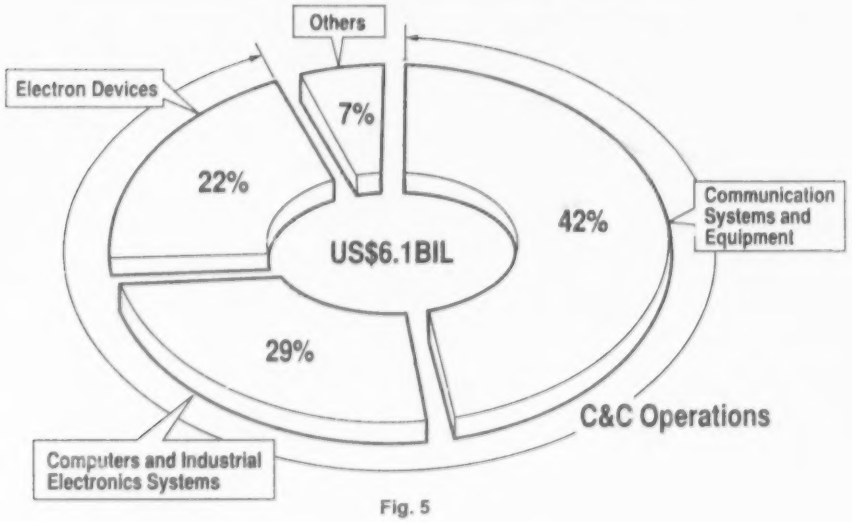


Fig. 5

Education and Training System of NEC

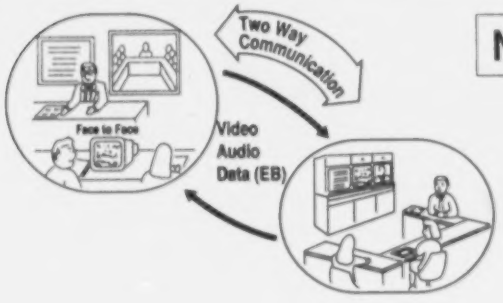
NEC

FUNCTION	ORGANIZATION
Employee Education	
• Orientation for New Employees	Personnel Relations Division
• Proffessional Knowledge and Skills Development	Institute of Technology Education NEC Technical College Functional Staff Groups and Line Business Groups
• Managerial Skills Development	NEC Institute of Management, Ltd.
Customer Training	
• Domestic Customers	Line Business Groups
• Overseas Customers	NEC International Training, Ltd.

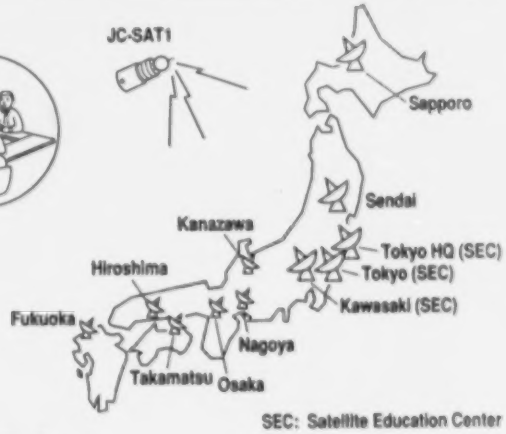
Fig. 6

NEC

Educational Communications in NESPAC



NESPAC Satellite Network



SEC: Satellite Education Center

Fig. 7

Educational Programs Using NESPAC

NEC

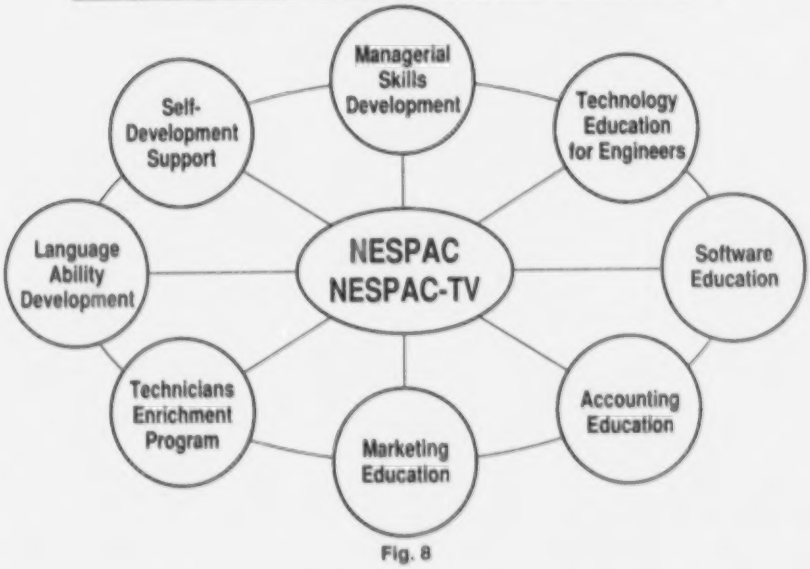


Fig. 8

NEC

Profile of NECITR

Established	: July,1990
Head Office	: Tokyo, Japan
Training Facilities	: 1) Training Centers - Tokyo - Tamagawa - Yokohama 2) Accommodation - Takaido House
Number of Employees	: 130
Major Services	: 1) Planning and Implementation of Technical Training 2) Organizing Seminars 3) Management and Operation of Accommodations for Trainees

Fig. 9.

NEC

Training in Japan

(Number of Trainees)

Fig. 10

NEC

Training in Japan

(By Subject in 1990)

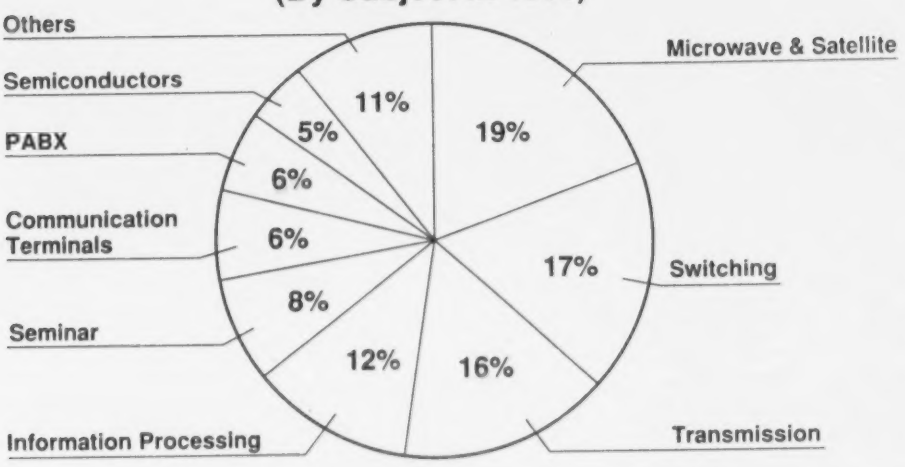


Fig. 11

NEC

Training in Japan

(By Region in 1990)

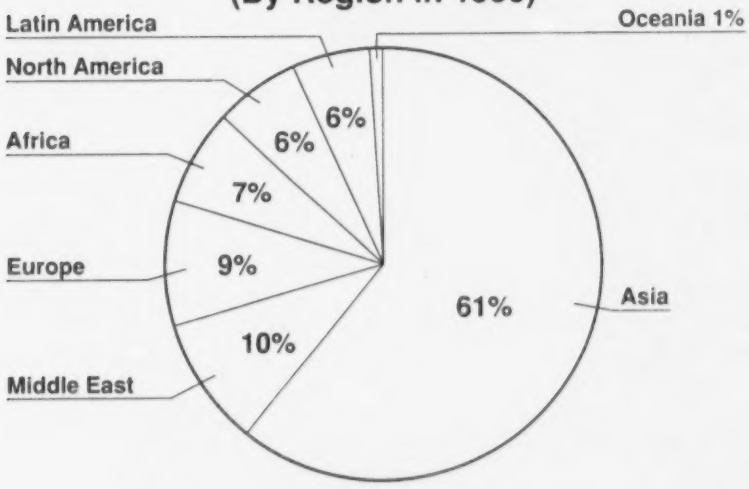


Fig. 12

NEC

Fig. 13

NEC

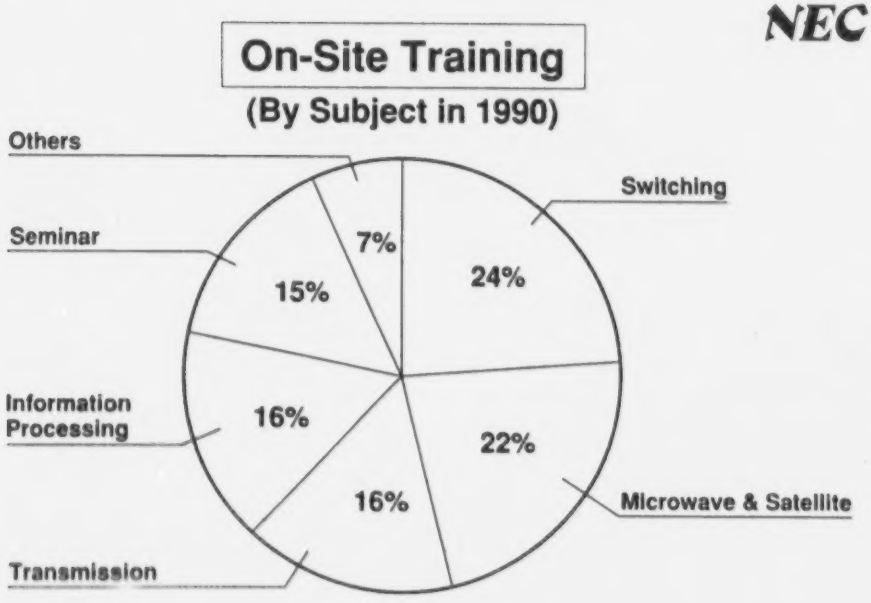


Fig. 14

NEC

On-Site Training

(By Region in 1990)

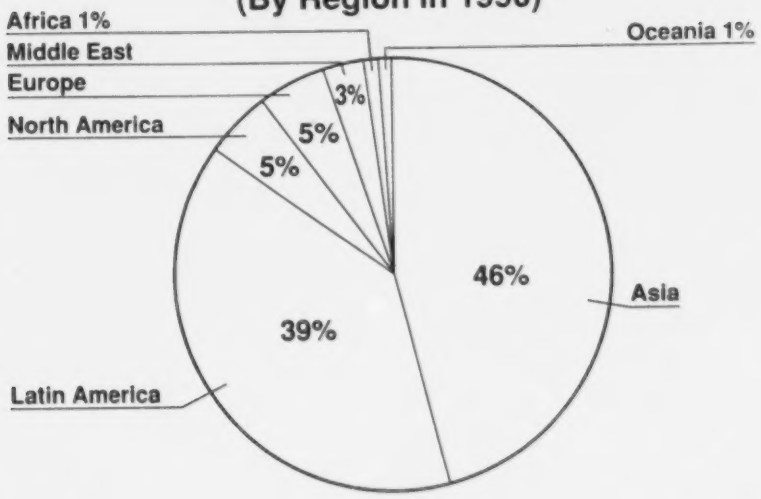


Fig. 15

NEC

Other Activities of NECITR

1. Products Training for Sales Engineers of NEC's Overseas Subsidiary Companies
2. Instructor Training
3. Japanese Language Training
4. Basic Technologies Training
5. Factory Tours
6. Study Tours
7. Home Visits to Japanese Family

Fig. 16

333

NEC Worldwide

NEC

(As of Aug., '91)

□ Manufacturing Affiliate	26 (29 Plants)	in 15 countries
○ Marketing & Service Affiliate	44	in 23 countries
△ Liaison Office	23	in 21 countries
TOTAL	93	in 43 countries

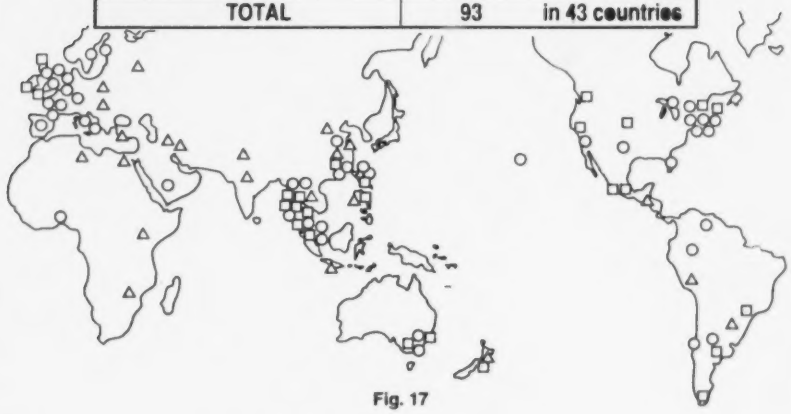


Fig. 17

Training in Japan

NEC

(Number of Trainees by Month)

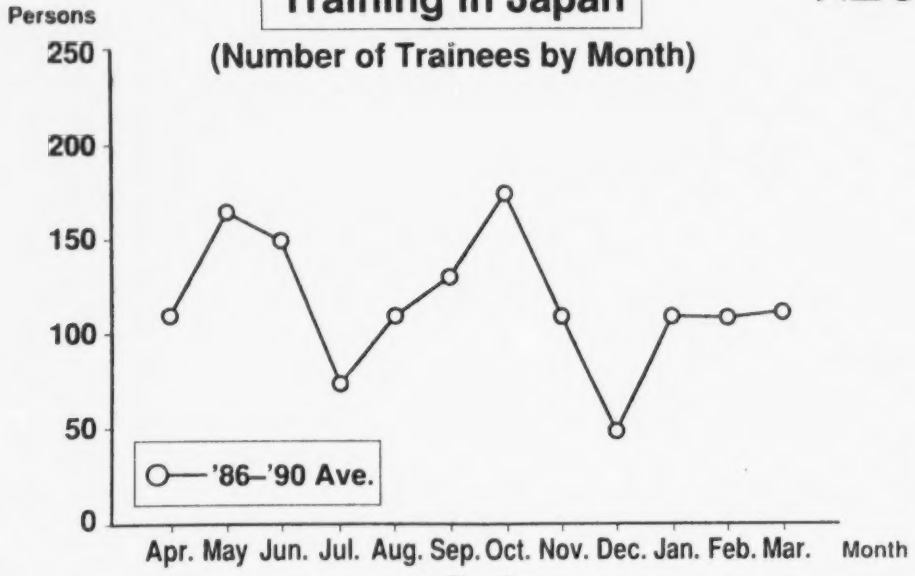


Fig. 18

NEC

Global Sharing System for Instructors

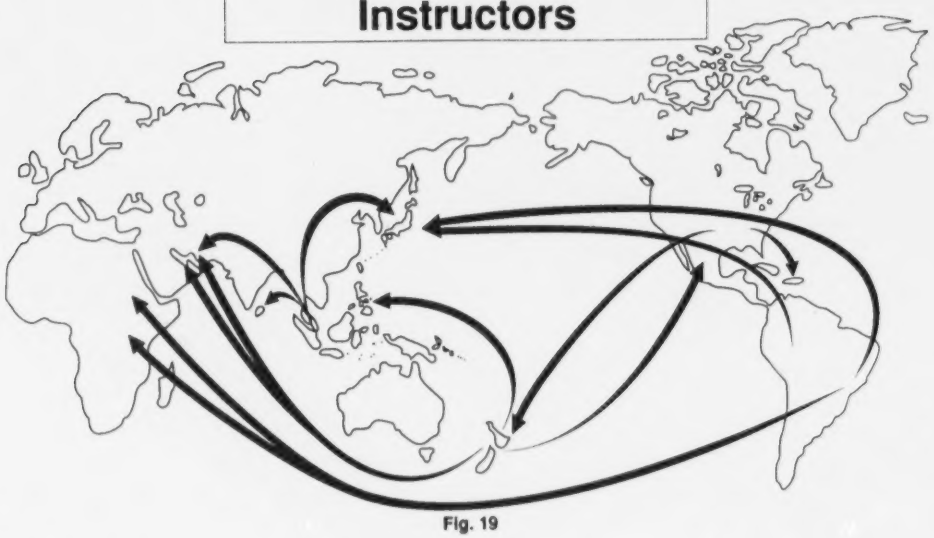


Fig. 19

NEC

Corporate Philosophy

NEC strives through "C&C"

to help advance societies worldwide

toward deepened mutual understanding

and the fulfillment of human potential.

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THE HARMONIZING OF PATENT AND COPYRIGHT LAWS OF PACIFIC RIM COUNTRIES

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ABSTRACT

The intellectual property laws of Pacific Rim Countries are reviewed. This review includes an analysis of the patent and copyright laws of Pacific Rim countries, notes differences in the various laws, and discusses efforts underway to harmonize the laws by the World Intellectual Property Organization (WIPO), headquartered in Geneva, and in the General Agreement on Trade and Tariffs (GATT) treaty negotiations. The laws on patents will be reviewed first, then the laws on copyrights, and the rapidly developing area of patentable software will be reviewed.

Intellectual property including patents on inventions and copyrights on writings, audio-visual material and other works of art, are capital assets and strategic tools in business planning. These types of intellectual properties can be of significant importance and value in the tele-communications field. However, differences exist in the intellectual property laws of Pacific Rim countries in recognizing and protecting intellectual property which impact trade between countries and investments in countries.

India, the People's Republic of China, and Thailand were reported in the BNA Patent, Trademark and Copyright Journal, Vol. 42, May 2, 1991, by the Office of the U.S. Trade Representative, to be among the worst offenders of intellectual property rights protection for, and market access to, U.S. citizens relying on intellectual property. Piracy of all forms of intellectual property was reported as widespread in China, which has offered neither product patent protection for pharmaceuticals and other chemicals nor copyright protection for U.S. works. However, new regulations for the protection of computer software in China became effective October 1, 1991. India has short terms of protection, broad compulsory licensing, and lack of protection for certain classes of inventions. Thailand was cited for failure to enforce copyrights and deficient patent protection.

This paper reviews the patent and copyright laws of Pacific Rim countries, notes differences in the various laws, and discusses efforts underway to harmonize the laws by the World Intellectual Property Organization (WIPO), headquartered in Geneva, and in the General Agreement on Trade and Tariffs (GATT) treaty negotiations. The laws on patents will be reviewed first, then the laws on copyrights, and the rapidly developing area of computer software protection will be reviewed.

PATENTS

Key issues in harmonizing the laws on patents are the definition of patentable subject matter and exclusions, the publication of pending applications, the terms of patents, and enforcement of patent rights including compulsory licensing. Other key issues include entitlement to patents by either the first inventor or by the first applicant to file a patent application, the requirement for absolute novelty when the application is filed versus grace periods based on pre-filing activities of the applicant and others such as publication, commercial use, and sale of the invention.

The U.S. and the Philippines are the last two countries to grant patents based on first-to-invent rather than the first-to-file a patent application. However, the section on Patent, Trademark, and Copyright Law of the American Bar Association has recently adopted a resolution favoring in principle adaption of the first-to-file rule in the U.S. if the adaption were part of a patent harmonization treaty, wherein other countries agree to changes in their patent system sufficiently beneficial to U.S. applicants and their assignees.

In Asia, Japan has one of the most developed intellectual property laws, and some countries in Asia have patterned their laws after the laws of Japan. While Singapore, Malaysia and Hong Kong as a crown colony are still influenced by the British legal system, the laws of the various countries remain diverse.

The definition of patentable subject matter typically requires novelty (absolute or with grace periods), industrial utility (as opposed to theoretical or scientific principles or mathematical algorithms), and non-obviousness (inventive merit) and supported by an adequate written specification. Exclusions can include inventions contrary to public order, health or morals, medical procedures on humans, pharmaceuticals, and certain chemical compositions including substances manufactured by the transformation of the atomic nucleus. The patentability of computer software remains an issue in most countries, as discussed later. Terms of patents can be measured from application filing dates or from patent issue dates. Compulsory licensing can be required for certain patented inventions

particularly in the medical field or if the patented invention is not being "worked" in the country granting the patent.

Most countries belong to the Paris Convention which accords the original application filing date to patent applications in other countries which are filed within one year of the first filing date. Notable exceptions include Taiwan, the Andean Group of South America, India, Thailand and Singapore.

In the ongoing WIPO negotiations the U.S. is being asked to make a number of changes to its patent laws besides the first to file right of priority. These changes include eliminating grace periods for publications and public uses of third parties, according to foreign applicants a one-year grace period for their own public use and publications from their first foreign filing date; making prior public use, sale or disclosure in foreign countries part of the prior art; eliminating secret commercial use by an inventor or non-public sale before the grace period as a basis for invalidating patents; and eliminating the experimental use exception to prior commercial use. Additionally, pending patent applications would be published two years after their filing date; and the term of U.S. patents would be set at 20-25 years from the filing date of the earliest U.S. application on which priority is based.

These provisions are included in a Basic Proposal Draft Treaty, negotiated by a Committee of Experts which has been meeting since July 1985 at WIPO in Geneva. The GATT negotiations in the Uruguay round of talks includes a Trade-Related Aspects of Intellectual Property rights, or TRIPS, negotiating group which has formulated an agreement with many of the basic provisions of the WIPO draft treaty included therein. This agreement was to be presented to the U.S. Congress as part of a larger trade agreement, but disagreements among the parties as to agriculture trade issues have stalled the GATT negotiations.

While the harmonizing of patent laws along the lines of the draft WIPO treaty will most likely occur, enactment of the treaty will probably depend on, and be part of, broader trade agreements. In the meantime, the U.S. is encouraging Pacific rim countries to review and strengthen their patent laws as necessary to accord protection for the patent rights of U.S. citizens doing business with and in the countries.

COPYRIGHTS

The Berne Convention has become the principal vehicle for the standardization of copyright protection worldwide. However, the following countries of the western Pacific region are not signatories to it: Burma, Laos, China, North and South Korea, Vietnam, Kampuchea (Cambodia), New Guinea, Indonesia, Taiwan, Thailand and Singapore.

The United States and several other industrialized countries have taken the lead in trying to convince these countries to reform their copyright laws. Their principal motivation and poli[illegible], of course, has been to ensure that owners of exported copyrighted works are adequately protected against domestic infringers in those countries. These industrial countries have been particularly active in multilateral and bilateral negotiations, in participating in the Uruguay Round of the GATT and in the WIPO. The United States, at least, has also sometimes threatened to impose trade sanctions against countries who refuse or are slow to amend their copyright laws to conform with "international trends".

The activities of the United States and the other proponents of strong international copyright protection are subject to countervailing policies adopted by many of the less developed countries. These countries view any restrictions on copying and any requirement of substantial compensation to foreign manufacturers and authors as being inconsistent with their own agenda for rapid economic and social development.

The United States has recently been a strong advocate for the inclusion of "western" standards for intellectual property protection in the GATT. In that forum, it has sought agreement among GATT signatory countries, including many of those listed above, to grant all of the "economic" rights guaranteed by the Berne Convention plus some additional obligations. As of this writing, the Uruguay Round of the GATT has resumed with copyright protection on its agenda.

Over the last two years, the WIPO has attempted to develop a consensus in favor of the adoption of a Model Copyright Law based upon the obligations of the Berne Convention. That consensus has not yet emerged; and WIPO's efforts have further revealed the underlying policy disputes between the needs of the industrialized and the developing countries. Nevertheless, most observers predict some sort of Model Copyright Law to emerge from WIPO within the next few years.

Japan is a member of WIPO and a signatory to the Berne and Universal Copyright Conventions. However, in the opinion of many, copyright protection in Japan for certain classes of works of authorship is seriously deficient. One of the most significant problems has been the double standard in the protection of sound recordings. The law had granted domestic manufacturers and performers considerable protection but had not extended the same rights to authors and owners of foreign works. As a result, pirating of foreign recordings and lack of compensation from rental shops was common.

Major revisions to Japan's copyright laws concerning the protection of sound recordings went into effect on January 1, 1992. Under the

recent amendments, foreign manufacturers and musical performers are now granted exclusive rights to their recordings for one year, after which they would be entitled to specified royalties for use of those recordings, including rental. These amendments give domestic and foreign recordings the same level of protection and therefore remove the double standard noted above. However, many in the recording industry feel that the short term of protection and extremely low compensation from rental shops leaves both groups of manufacturers and artists substantially undercompensated.

Until recently, South Korea had virtually no copyright protection either for foreign or domestic authors. In 1990, the International Intellectual Property Association requested that the United States Trade Representative identify and investigate South Korea because of its inadequate enforcement of copyright laws.

As a result of this and other pressure, the government has enacted significant reforms. South Korea now has a copyright registration system and other services and procedures which make protection more feasible. South Korea is a signatory of the Universal Copyright Convention but not to the Berne Convention. It is not a member of WIPO.

Despite some progress in reforming its copyright regime, South Korea remains a major problem area to foreign exporters because of its failure to enforce its new laws. Fines for infringement are still minimal and jail sentences are rarely imposed, even for repeat offenders. Counterfeiting and piracy of videos, textbooks and computer software are still the norm rather than the exception.

Thailand has long been among the worst countries of the region with respect to providing copyright protection to foreign authors. Particularly notable are its onerous compulsory licensing laws. The government can require foreign firms selling copyrighted works in Thailand to license those works to Thai firms for nominal fees.

In 1987, the Thai government submitted new copyright laws to its Parliament which would have improved the situation dramatically. However, the legislation caused a no-confidence vote and Parliament dissolved. Ever since, Thailand has refused to amend its copyright laws despite particularly intense pressure from the United States.

Like Thailand, the Philippines affords very little protection for copyrightable works. There is no protection for sound recordings, for example, and very little in the way of enforcement for any works of authorship. Like South Korea, the government of the Philippines has instituted a compulsory license system for certain classes of works, including textbooks and reference books. Its copyright laws also contain formalities which are incompatible with the Berne and Universal Copyright Conventions.

Several years ago, Hong Kong amended its copyright law to bring it into closer conformance with emerging international standards. However, recent proposed changes have caused some to question Hong Kong's commitment to vigorous copyright protection. Those proposals include decriminali-zation of copyright infringement and the termination of search and seizure raids upon allegedly infringing manufacturers. The outcome of these proposals bears watching.

Of all the countries in the western Pacific region, the People's Republic of China has perhaps made the most progress in recent years in instituting copyright protection which is compatible with international trends. Its first copyright law became effective last June, and it purports to protect the moral and economic rights of Chinese and foreign authors alike.

However, much work remains for the PRC. The new law only protects foreign works first published in China and other foreign works to the extent protected by international treaties to which the People's Republic has acceded. Since it hasn't acceded to any international treaties yet, the practical effect is that foreign works first published elsewhere are virtually unprotected. The new law also provides for compensation for damages "according to circumstances". This is, of course, a very subjective standard which makes for considerable uncertainty and a lack of predictability in the area of enforcement. The law provides that anyone can use published works without permission of the author except when the author issues a statement prohibiting use of the works. Finally, China has promised to issue regulations which would assist in implementing the new law. To date, no such regulations have been issued. Thus it remains to be seen to what extent China's new copyright law will actually improve copyright protection for both foreign and domestic authors.

We expect the developing countries to continue to resist enhancements of the rights of foreign copyright owners, although the pace of change has increased in the last few years. As the foregoing survey shows, however, much remains to be done to harmonize the copyright laws of the western Pacific region countries with the Berne Convention and other international standards adopted by the more industrialized countries.

PATENTABLE SOFTWARE

The United States Patent and Trademark Office (USPTO) has published guidelines regarding the questions of patentable subject matter that relate to computer programs and, more particularly, to mathematical algorithms.

A mathematical algorithm has been defined under U.S. case law as a procedure for solving a given type of mathematical problem. A mathematical algorithm is, per se, not patentable subject matter; however, a patent application drawn to subject matter otherwise patentable does not become unpatentable simply because it uses a mathematical formula, computer program, or a digital computer. The USPTO has adopted a two part test for mathematical algorithm, and whether it satisfies as statutory subject matter (i.e., whether a claim of invention preempts non-statutory subject matter as a whole requires a two step analysis).

First, it must be determined whether the claim directly or indirectly recites a mathematical algorithm, for a claim which fails to even recite an algorithm clearly cannot wholly preempt the algorithm itself.

Secondly, if the claim does recite in part a mathematical algorithm, the claim must be further analyzed to ascertain whether in its entirety it wholly preempts that algorithm.

The USPTO has been wrestling with this particular area in connection with patentable subject matter, particularly in view of the large number of patent applications filed with utilize some form of a computer program or computer process.

In a recent case (1989), the United States Court of Appeals for the Federal Circuit upheld the patentability of subject matter that included a mathematical algorithm. In that case, an approximation to a conventional equation for autocorrelation coefficients had been developed for use in pattern recognition. The applicant in that case had claimed a Read Only Memory (ROM) as part of the apparatus. The Court of Appeals for the Federal Circuit was satisfied that that the claim of patentable subject matter was for a specific piece of apparatus, and therefore that the second part of the two part test was not met. As a result, the subject matter was found to be patentable.

The USPTO is evaluating such applications on a case by case basis, and is looking carefully toward whether the first part of the test is met (whether the claim directly or indirectly recites an algorithm); and secondly, whether the claim in is entirety wholly preempts the mathematical algorithm.

It is the USPTO position that mere recitation of structure (such as a ROM) within the claim does not necessarily mean the claim passes muster. However, once it is determined that the claim is truly drawn to a specific apparatus, it necessarily follows that the apparatus is statutory subject matter. True apparatus does not invoke the mathematical algorithm exception, because the mathematical algorithm remains free for use by anyone not employing the specific apparatus, i.e., there is no preemption in whole or in part of the mathematical algorithm itself.

However, if the applicant in a particular case includes the recitation of a "means" for performing a specific function, the USPTO position is to look very carefully at such recitations. Such types of claims are given their broadest reasonable interpretations and then it is the applicant's burden to show that the functionally defined disclosed means do not encompass any and every means for performing the recited functions, because otherwise such an interpretation would then preempt the mathematical algorithm itself.

Hence, the applicant has the burden of satisfying the USPTO of the adequacy of the claim language with respect to mathematical algorithms.

Other Patent Offices have adopted the same or similar views in connection with computer software.

For instance, the Australian Patent Office has adopted the same test as developed by the U.S. Courts; however, this is not to say that inconsistencies of application do not occur in particular cases in Australia. However, the general approach of Australian practice in this area is similar to that of the U.S. practice.

In the People's Republic of China, the Chinese Patent Office is currently taking the position that, in the case where a patent application is involved only in computer programs or mathematical algorithms, no patent protection will be granted for these programs or algorithms. However, in the case where a patent application is involved in a system, device or apparatus that comprises an interacted combination of a plurality of pieces of software and hardware, then that system, device or apparatus may be granted protection for its technical solutions as a complete self-contained entity.

The Japanese Patent Office also does not provide patent protection for a mathematical algorithm, per se. The patentability of an invention in Japan related to a computer program or mathematical algorithm is first subjected to a test to determine whether or not the software is combined with specific hardware for application to a specific field of industry. Examples of such cases are electronic calculators, IC cards, wordprocessors, and electronic game equipment. In such examples, software stored in a ROM provides a specific function in combination with the hardware. This type of invention could be patentable in Japan (presuming the other requirements for patentability are satisfied).

In areas in Japan where the software is not tied to a specific piece of apparatus, a further test is carried out to determine whether or not the software utilizes a specific property or structure of hardware resources provided for a computer system. If the result of the test is affirmative, a further test is made to determine whether or not the software can be recognized as a method for controlling or effectively utilizing the specific property or structure of the hardware resources, or whether the function provided by the software can be grasped as providing a device as being combined with the hardware resources. This is illustrated in cases such as operating systems, file access controls, file control systems, and the like.

In the Republic of China (Taiwan), mathematical methods are treated similar to scientific principles, much as in the United States,and are not considered patentable.

The test in Taiwan appears to be similar to that of the U.S. in terms of whether a computer is substantially used and, if so, whether the computer is substantially an apparatus.

The position of the South Korean Patent Office is apparently that computer software itself cannot be protected by a patent in South Korea. A process patent may be claimed in a case where computer software is used for the operation of machines. As is the case in the United States, a mathematical algorithm, as such, cannot be the object of a patent because a mathematical algorithm does not use a natural law, but is considered to be a representation of the natural law itself. A process patent in South Korea may be claimed only in the event that a natural law has been used in the computer software for the purpose of solving a specific problem.

INFORMATION TECHNOLOGY-LED DEVELOPMENT: CAN THE LESSONS BE TRANSFERRED?

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1. ABSTRACT

Although advocates of technology-led development claim that information technology (I.T.) is a leading sector for national development, the policies required to obtain this potential are unclear. This policy research paper contrasts a decade of efforts by the governments of Singapore and Thailand to use I.T. to support their economic and social development, indicates why I.T. policy which is successful in one context may not transfer to another, and recommends an agenda for national I.T. planning.

2.0 INTRODUCTION

Information technology (I.T.) is not new to Asia [1]. However, recent trends in technology development, in the use of information in the economy, and in the interaction between the public and private sectors raise the value of I.T. as a development tool. The issues generated by these trends are similar in developed and less-developed economies.

2.1 I.T. AND DEVELOPMENT

From the functional perspective, I.T. includes material objects and related techniques used to capture, store, retrieve, process, transform, transmit, or display machine-readable information. From a user view, I.T. is the "package" of hardware, software, and techniques required over the life of an application [2]. This package also includes the arrangements necessary for use, and thus implies skilled technical workers, knowledgeable managers, and competent users. Policy affects these resource factors, and influences organizational motives to adopt new technology.

Increasingly, sound I.T. policy can make a strategic contribution to national development, because: (1) Capability and performance are increasing, while costs have declined, (2) Individuals and organizations are rapidly learning to use this new technology, and perhaps more importantly, (3) data processing and telecommunications technologies are converging, so that I.T. can now be used to facilitate interorganizational and international cooperation, with dramatic consequences for national development.

2.2 FALLING COSTS, RISING CAPABILITIES

Long ago, radio and television signals crossed national borders. Motorola's recently announced plan for a global mobile cellular system linked via 77 "Iridium" satellites will enable users to make and receive calls from anywhere in the world [3]. Today's technology-led revolution, based on freedom from national cable-and-wire networks, will reshape international trade links.

Hardware costs have fallen more than twenty percent each year over two decades. Improved software-based capabilities to manage information and in data transmission speed and computing power are equally important. Computer-aided vision can now improve product quality, and other tasks which were once technically impossible or uneconomic can be automated. Combined, these trends in technology open more possibilities for I.T. use than can be implemented, and discretion must be exercised to align new uses with long-term objectives.

2.3 RISING EXPECTATIONS, LAGGING SKILLS

Such successful uses of information technology are widely publicized, and expectations have risen. However, successful use of any new technology requires both technical and management skills, plus a supportive organizational and social environment. This means that planning for the public sector use of information technology must be carefully integrated with manpower development planning and public education.

2.4 CONVERGING TECHNOLOGIES

When computers and telecommunications were based on divergent technologies, data transfers between computers were difficult and expensive. As digital designs replaced analog circuitry, the technological basis for computer and telecommunications hardware converged, thus facilitating interaction between computers at different sites. This trend means that policy and planning for the use of these two information technologies must now be integrated.

3.0 I.T. AND NATIONAL COMPETITIVENESS

Harvard Business School Professor Michael Porter's model of national competitive advantage [4] portrays industrial restructuring as a process of reconfiguring the joint efforts of multiple enterprises in selected industries to make them internationally competitive. According to Porter, economic linkages, geographic location, and market structure are key factors within an industry. External to an industry, the focus is on the effect of public policy on the business climate, public investment, trade facilitation, and the climate in which technology is developed, transferred, and used. Only product innovation and reconfigured value systems for key enterprises in specific industries (and not low wages or raw materials) provides sustainable national competitive advantage.

Public and private sector organizations create value through a combination of physical and information activities. Banks and many Ministries deal mostly with information. Cement manufacturers and public works crews mostly carry out physical activity, but also generate and use information. Some organizations are highly dependent on information flows: neither international airlines nor modern hospitals could function without computers and telecommunications.

If information adds value to activity (e.g., airline ticket data is used for scheduling, pricing, and billing), rapid information flows may improve financial performance. The Singapore Tradenet case[5] illustrates how information technology affects business velocity.

International trade revolves around information: about the goods, the parties at interest, the modes of transport, the dates of departure and arrival, and the payment of various fees and the exchanges between the parties. To defend its role as a leader in port services, Singapore first automated operational processes in trade-related public agencies. "We were able to turn Customs and Excise into an agency that speeds up trade, not slows it down," according to the agency Director-General, Lee Yew Kim. The strategic payoff came only later, when the government built the Tradenet value added network to provide on-line links to the entire trading community, including Customs and Excise, the Trade Development Board, sea and air ports, shippers, receivers, air cargo operators, freight forwarders, banks, and insurance agencies, across international boundaries. Within two hours of notification by an arriving ship, freight forwarders using Tradenet can obtain import permits, clear customs, pay duties for cargo going ashore, and obtain export permits for outbound cargo. This case demonstrates that (1) telecommunications and computer technologies can be sources of national competitive advantage, and (2) the public sector role in planning and implementation is critical.

This paper compares the I.T. policies of two dissimilar South East Asian nations. Singapore is an entirely urban island nation located near the equator at the southern extent of the South China Sea, with a population of 3 million occupying just over 600 square kilometres. After its 1959 independence, Singapore's infrastructure investments and policies encouraged growth in distribution, trading, and banking services, and in light industries such as electronics. Its success in the 1970's was accompanied by high employment and rapidly rising wages. Social development policies were primarily directed toward functional goals such as housing and health care. By 1990, per capita domestic income exceeded U.S. $10,000, and health, literacy, and other development measures exceeded many industrialized nations [6].

Bordered by Malaysia to the south, Burma to the west, Laos to the northeast and Kampuchea to the east, Thailand's 514,000 square kilometres shelter a population of 57 million people. Agriculture is the mainstay of the Thai economy, and its industries were originally linked to agriculture. Import substitution policies gave way to an export orientation in the early 1960's. Growth was slow until the 1980's, when foreign investment and construction multiplied, and the economy grew at a sustained rate of nearly 10 per cent. Today, a structural shift from agriculture towards industry, and from increasing production volume towards improving efficiency and quality, are seen as prerequisites for competitiveness in the rapidly changing world economy. The current per capita domestic income is about US $ 1400 [7].

4.0 SINGAPORE

In 1980, Singapore policymakers envisioned a post-industrial society in which high technology and new skills would displace labor intensive industries, and information would become

a primary economic good. In the interim, automation and widespread use of information technology in the private and public sectors, supported by the introduction of technological culture to the community, would raise productivity. Central control of short and long-term incentives (balanced with powerful disincentives) allowed policymakers to influence supply and demand and to regulate entry in key markets [8].

Using this power, it took Singapore only one decade to put a national information technology infrastructure in place, to develop systems to support essential government activities, and to accelerate the use of information technology by private and public organizations outside the government's direct control.

4.1 SINGAPORE, I.T., AND DEVELOPMENT

By 1980, simple factor endowments (raw materials and unskilled labor) were declining in strategic value over time, while international competitiveness demanded more advanced factors (specific skills, scientific infrastructure, and access to high-technology services and supplies). Singapore policymakers expected public sector computerization to increase productivity, to provide a visible example to the private sector, and by upgrading the infrastructure and labor force, to attract investment from higher-level industries. Thus, computer and telecommunications infrastructure became a formal element in the national development strategy [9].

Formed in March 1980, the Committee on National Computerization (CNC) shifted the economic role of information technologies in the private sector and in the government. By 1980, hardware was the least expensive element of the labor-intensive systems development process, and manpower was the limiting factor. The strategic transformation from a labor-intensive to a value-added economy demanded improved public sector information management, and Singapore's emerging role as Southeast Asia's telecommunications hub required software development and maintenance services. Those sectors received priority [10]. The CNC under the Minister of Trade and Industry, focused on developing the human resources and infrastructure necessary to build a core of information systems for the government. The CNC formed the National Computer Board, a special-purpose agency outside most Civil Service controls, to carry out this task. NCB formed a wholly owned software house and a commercial training firm, and at one point employed one-fourth of the national pool of skilled manpower in support of the Civil Service Computerisation Programme (CSCP) in key ministries [11]. The realization that the supply of technology must be coordinated with demand was attributed to a private sector marketing executive on the CNC panel. This simple principle permeates the Singapore I.T. strategy.

4.2 TECHNOLOGY TRANSFER DEMAND FACTORS

Powerful incentives increased the demand for information technology products and skills [7]. The Economic Development Board (EDB) policies shifted resources from labor-intensive to skills-based firms. US $ 50 million per year in employer payroll taxes was devoted to grants and subsidies for training and development programs. Low-interest EDB loans helped local firms buy hardware. The EDB also subsidized I.T.-related consultants. Tax policy was changed in 1983 to allow full first year write-off of most computer-related equipment, and no import duties were levied. These measures reduced the organizational cost and risk of adopting I.T..

The Civil Service and government-owned enterprises brought the first computers to Singapore in the late 60's and early 70's. The Ministry of Defence acquired minicomputers, while a mainframe and systems group in the Ministry of Finance served several agencies. However, the public sector was slow to adopt telecommunications or new technologies such as word processing. The Ministry of Finance tightly controlled most public sector computer acquisition and services during this era. During the later CNC era, new I.T. was more welcome. Microcomputer use exploded. Word processors were widely used. The public sector became a major user of I.T. products and services. By mid-1985, the CSCP ministries operated 16 mainframes and superminicomputers, with a total on-line data storage capacity of ninety gigabytes (million million) characters [12].

4.3 TECHNOLOGY TRANSFER SUPPLY FACTORS

The EDB actively courted overseas sources of information technology, while NCB encouraged small software houses to compete with large computer companies. Many experienced computer professionals working in Singapore were expatriates in temporary roles, working for vendors in product support roles or on contract to clients. The 500 computer installations of all types in Singapore were staffed

by only 850 I.T. professionals in 1980. The few public sector analysts and programmers were supporting obsolete batch systems. From this narrow base, the Singapore manpower pool increased to more than five thousand computer professionals by 1986 [13].

The nation's compact size facilitated the development of its communications infrastructure, and the state-owned Telecoms Authority (TAS) led South East Asia in voice and data communications technology. Most data communications flowed over leased lines until modem licensing was liberalized in 1983. By 1985, TAS provided direct links with more than 200 international destinations through its extensive undersea cable and satellite network. TAS offered packet-switched communications, facsimile transceivers, electronic mail, telex, and database (Datel) services, and its cellular mobile telephone and radio paging services grew rapidly [14].

4.5 EVALUATING NATIONAL POLICY

The CNC strategy leveraged Singapore's foreign trade links to acquire skills and technology which would not otherwise have been attracted to Singapore's small market. Outward transfers of locally developed technology (either within the region or to industrialized markets) was a low priority. A six-fold increase in the number of working I.T. professionals over a six-year period was remarkable because they were fully absorbed by the local market [15]. This reflects the success of CNC policy to reduce risks, costs, and other obstacles to change.

5.0 THAILAND:

Six five-year national economic and social development plans have guided development in Thailand from 1961 to 1991. Awareness of the role of science in national development is a fairly recent trend, first expressed in the Fifth Plan. Information technology is seen as a tool to improve communications and accelerate national development. Over the past five-years, the Ministry of Science, Technology and Energy has greatly strengthened the national science and technology infrastructure, while the Ministry of Transport and Communications worked to build a modern communications infrastructure as a platform for industrial development.

5.1 DEVELOPMENT STRATEGY

The industrial element of Thailand's economic and social development plan is based on the "lead industries" concept. The Ministry of Science, Technology and Energy (MOSTE) identified the electronics and information technology sector for promotion and expansion. MOSTE plans to strengthen national technological capability and to coordinate technology policy by [16],

1. Expanding science and technology cooperation agreements with technologically advanced nations.

2. Improving production efficiency and quality.

3. Forming a Committee which will promote information technology research and development, study a "Data Processing Zone" concept, and support I.T. and telecommunications services.

4. Revising laws and regulations which obstruct the development and use of I.T. and communications.

5. Restructuring the telecommunications sector and its publicly owned enterprises.

Thailand's central planning body is the National Economic and Social Development Board (NESDB). Its work is to formulate National Five-Year Economic and Social Development Plans and annual development plans, to study, analyze, and recommend solutions to development opportunities, to align development projects with the National Plan before implementation, to coordinate programme and project implementation in accordance with policies declared in the Plan, to monitor and evaluate development programmes and projects, and to facilitate communication [17].

The NESDB technology policy vision for the next five years focuses on human resources, technological research and development, technology transfer from foreign sources, and telecommunications infrastructure.

5.2 DEMAND ISSUES IN THAILAND

The more recent I.T.-linked institutions include the National Computer Committee (NCC) formed in 1984 and the National Electronics and Computer Technology Centre (NECTEC) formed in 1986. These two bodies have had very different development impacts. The National Computer Committee (NCC) is under the Bureau of the Budget. The cabinet established the NCC to scrutinize requests to purchase and use computers

in 1984. It has served to control, rather than to promote, computer use by public agencies. NCC has no permanent staff and relies on expertise from government agencies. This slows the approval process. Although NCC recently liberalized its controls, public sector computerization has been slow, while interagency systems or efforts at data integration are still unusual [18].

The National Electronics and Computer Technology Centre (NECTEC) mission is to develop technological capabilities in electronic and computer technologies; support the electronics and computer industry of the country; accelerate the computerization of Thai society in order to improve efficiency and productivity; promote research and development, and support industrial promotion and international competitiveness of Thai products. NECTEC, the bridge supporting the development and transfer of I.T. to local industry, has several small-scale successes to its credit.

In Thailand, it is the private sector (using the media) which most strongly influences public behavior and opinions about new technology. Individuals and organizations rapidly adopted I.T. tools even though the unique Thai language character set was not compatible with imported computer display and output devices. Researchers who studied these problems designed tools to support Thai language applications. Two well-known Thai language research products are Wor Tor Tor and the Thai Kernel System.

The Wor Tor Tor Thai system stems from a NECTEC project to develop an application programming interface for Thai system developers. It works with standard displays under the MS-DOS and UNIX systems. The Thai Kernel System (TKS) provides Thai application packages for general use. Currently available TKS packages include a Thai word processor, spread sheet, database and presentation graphics. Both were developed in local universities with MOSTE support [19].

5.3 PUBLIC SECTOR COMPUTERIZATION

Prior to the microcomputer boom, only large government offices in Thailand used computers, mostly for financial data processing and engineering computation, while public utilities used computers to print bills. Computer use expanded very rapidly with the advent of microcomputers, and some government offices are building new systems. For example, the Ministry of Interior completed a population registration project that won the 1990 Smithsonian Award for outstanding computer projects. The office of the Prime Minister uses image processing to track all cabinet resolutions, and plans to link the mainframes of four different ministries via a new wide area network [20].

The government relies on four bodies to plan and implement different public administration information systems. These are the Committees (a) on National Management Information System, (b) National Geographic Information System, (c) National Document Information System, and (d) the recently established National Telecommunications System and Information Technology Development. Although the government tasked the members to produce useful guidance and practical systems, the committees are moving slowly [21].

5.4 PRIVATE SECTOR INVOLVEMENT

In Thailand, the private sector and the government jointly promote and accelerate the process and progress of economic development. A growing awareness of common responsibility in the development process has expanded this cooperation, as increased private sector representation and participation in development projects demonstrates. The presence of major computer vendors [IBM, SAHAVIRIYA, etc.] and of the telecommunications services in support of industrial producers, international banks, and the multinationals is a factor in the development of the information technology community. Professionals from vendor organizations and multinationals form the core of key I.T. organizations such as the Computer Business Committee of Thailand.

5.5 INCENTIVE AND CONSTRAINTS

The Board of Investment (BOI) seeks investment from overseas, and has the power to grant tax exemptions and other privileges. To protect jobs for Thais, the use of foreign technicians and experts is controlled. Work permits can be obtained, but delays are commonplace.

Most large companies and industries in electronics and telecommunications manufacturing are foreign-owned or multinational enterprises. They rely on overseas offices to monitor technology development and to introduce any innovations. Many are export oriented and thus do not respond to Thailand's domestic needs. Others engage only on the finishing and assembly of imported

components, which limits the need for advanced I.T. capabilities.

5.6 TELECOMMUNICATIONS

The Telephone Organization of Thailand (TOT) and the Communications Authority of Thailand (CAT), state-owned monopolies, share responsibility for telecommunications services. TOT provides domestic, and CAT international service. Shortages of funds for expansion and limits on foreign exchange borrowing have limited investment, leading to a high level of unmet demand for basic telephone services, reduced quality of service to existing subscribers, and a lack of advanced services for business users. There are now only 1.8 million telephone lines, or 3 lines per 100 citizens, and an imbalance in the urban and rural distribution of service [22]. Radio-based services such as cellular mobile, radio telephone and paging service are growing, and help to offset the shortage of land-lines. The Seventh Plan aims at 5-6 million lines by 1997, or 10 telephone lines per 100 citizens [23].

5.7 R&D IN TECHNOLOGY

Because investment in R&D is only 0.1% of total investment, public funding of R&D is highly leveraged [24]. I.T. research in Thailand originated with NECTEC, which establishes R&D centers in target areas, provides funds for R&D work, industrial product development, and for researchers in universities and companies. NECTEC enables technological cooperation via tripartite arrangements linking NECTEC resources with users (local manufacturers) and researchers (at Thai universities). NECTEC will soon be merged with the Science and Technology Development Board [25].

5.8 SKILLED TECHNICAL MANPOWER

While I.T.-based industries need skilled labour, engineers, technicians, and I.T. specialists, these are in short supply. University output of engineering and technical manpower is inadequate across all sectors, particularly in data processing. The shortage is chronic in government departments and state enterprises. Although in 1987 9.1% of all employment was classified in S&T-related occupations, only about one-fourth had any secondary education. The low proportion of students entering and completing secondary school contributes to a scarcity of quality graduates[26].

The Seventh Plan targets science and technology manpower, technology transfers through foreign investments, and basic services in science and technology. Human resources development is one of its major targets [27].

5.9 TRAINING AND EDUCATION

Training programs offered by the private sector tend to focus on the application of products, while those organized by the public sector are resource-limited. Many larger organizations (banks, MNC's and high-technology industries, and technology-based state enterprises such as the TOT) provide internal training. Overseas training may be the only viable source for smaller private firms.

6.0 COMPARISON AND ANALYSIS

Singapore, with the time-critical but clear task to maintain its international competitiveness, was able to focus on a few critical issues, mobilize the needed political, financial, and economic resources, and build the organizational capacity to address those issues. Within the five years from 1981 to 1986, Singapore advanced from a nation with a shortage of I.T. resources to one which could integrate its I.T. capacity into its national economic plan. By 1991, Singapore firms were exporting branded software in direct competition with US and European producers, while the domestic I.T. infrastructure was so advanced that it was becoming a model for other nations in the region.

In contrast, Thailand still lacks clear Information Technology policy. For example, telecommunications development is not linked to the nation's electronic equipment manufacturing industry. Neither market nor technological information on telecommunications and electronics are available, and emerging information technology around the world cannot be adequately monitored. Another weakness is the lack of a framework for I.T. policy. Driven only by the private sector, the new technology is diffusing rapidly throughout urban Thai society, but providing few public benefits. The public sector could take a leadership role to use information technology to support national development, but the policies which are required have not been clearly articulated to date.

In both countries, an inhibiting factor for future I.T. development is the unwillingness of the local private sector to invest in research and

development, and the resulting weak linkages between the university research community and industry. While the private sector stands to gain most from local I.T. capability, they have been little involved in research work being carried out in the universities and the polytechnics. In Singapore, this gap was caused primarily by a lack of post-graduate programs and a very strong emphasis on teaching. Singapore overcame this problem by providing large subsidies to research projects and appointing prominent business leaders to serve on the governing boards of research institutes, while slowly building up its post-graduate programs. Thailand focused on developing a local market for contract research to be carried out by its more mature post-graduate centres.

7.0 RECOMMENDATIONS

The primary lesson from Singapore is that a clear and comprehensive I.T. policy helps in coordinating general industrial policies, S&T policies, manpower development programs, and telecommunications plans. Development of such policy must involve the public sector (at the inter-ministerial level) and large private sector organizations which can realign their resources to support the plan. As technical inputs will be needed, qualified experts should also be retained. But strategic technology and industrial development policies must be in harmony with other policies. Information technology can play an integrating role for technology, industry, social, and development policy. As a first step, the following is suggested as the agenda for national I.T. policy formulation:

7.1 NATIONAL I.T. MANPOWER RESOURCES

Manpower is and will continue to be the limiting factor. Thailand must invest now and develop professionals who are not only able to deal with technological change, but capable of helping firms exploit I.T. for productivity and competitive advantage. The government should increase university and technical school output, and provide incentives to encourage in-service training. These scarce human resources must be shared between the public and private sector to enable the efficient interchange of information. The public sector might also serve as a training ground and provide a pool of experienced technical professionals and managers to industry.

7.2 ORGANIZATIONAL CULTURE FOR I.T. USE

The transition to an information-based economy will require massive changes in organizational culture. In order for these new forms to be adopted, the value of I.T. must be recognized. Public sector agencies must demonstrate the value of I.T., and seek opportunities to prepare workers, managers at all levels, and policy makers for the information era. The schools and ministries most closely linked to industry are the logical initial target in Thailand.

7.3 DATA COMMUNICATIONS INFRASTRUCTURE

The economic value of information is greatest when it can be used as a substitute for physical activities. High-speed data highways will be needed to link public sector agencies, first with each other, then with the private sector. The emergence of mature ISDN technology during the past decade greatly simplifies this task.

7.4 PUBLIC DATA RESOURCE MANAGEMENT

The data highways will be useless unless public information about people, institutions, and physical resources is accurate, properly safeguarded, and well-managed. The design of the public database and the management of public information may be the most challenging of the technical tasks which lie ahead.

7.5 LINKING I.T. AND DEVELOPMENT PLANS

The desired relationships between public agencies, between these agencies and the public, and between the public and the private sector must be clearly defined. This is the strategic context for tactical decisions: Which public sector functions to automate? Which data to share? What data highways to build? These decisions must be linked to national policy, which must in turn reflect national development plans.

7.6 INFORMATION RESOURCE POLICY

To influence the long-term commitments which will be required to implement national I.T. plans, I.T. policy leadership must have solid credibility in both the private and public sector, and with different functions in the public sector. It is essential that these key players are not only involved with, but committed to the process.

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Telecommunications in Local Municipal Governments

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Effective telecommunications is becoming more and more important to local city and county governments in their increasingly difficult job of providing cost effective services to their constituents. Voice and data services within government and between government agencies and their clients are key operations and must be effectively managed and controlled.

Managing telecommunications is a major challenge facing local governments today. As the need for distributed processing grows and the dependance on a centralized mainframe located in a data center diminishes, these organizations are looking to creative solutions to meet telecommunications needs. This is further complicated by the organizational autonomy within local governments. In addition, the general public (constituents) are looking to the government for increased services in the form of information. Information that was once tied up in bureaucracy and paperwork is now being demanded on-line.

To meet this challenge, local governments are beginning to take a variety of steps in managing telecommunications. In this paper we have discussed some of the factors that make this a valuable but challenging task.

Introduction

Telecommunication in local municipal governments is critical to their overall operations. The telecommunication function is often provided and administered by several different agencies within most local municipalities. Often unique resources available only to municipalities are under utilized in providing telecommunication service. A comprehensive look at local government telecommunications helps in the development of a plan and the leveraging of the municipality's assets. As a result local governments can improve telecommunications services, reduce spiraling costs and even provide some revenue generating services.

ORGANIZATIONAL CHALLENGES

Developing an effective and flexible telecommunications system is a formidable challenge for any organization. While local governments have some unique advantages in this area, they also have certain disadvantages. These unique
advantages and disadvantages may not apply to all local governments, but they have emerged often enough in our analyses that they are worth discussing. Unique advantages to local governments include:

- Assets that enhance local government telecommunications capabilities
- Experienced, trained personnel
- Access to Right of Way
- Facilities and Buildings

Some of the disadvantages facing local governments are:

- Lack of awareness concerning the importance of telecommunications
- Failure to coordinate telecommunications systems and their development
- Inefficient use of telecommunications expertise
- Absence of a telecommunications master plan

ADVANTAGES AND DISADVANTAGES TO TELECOMMUNICATIONS DEVELOPMENT IN LOCAL GOVERNMENTS

Assets that enhance local government telecommunications capabilities

Local Governments are in a unique position as telecommunications users, despite some inherent disadvantages discussed above. Cities and counties have access to many assets within their jurisdiction that could be exploited to enhance their telecommunications capabilities. Unlike most organizations, these local governments are not entirely dependent on their vendors for telecommunications facilities and are frequently capable of providing most of their own services. Local governments can use some of these assets to not only reduce telecommunications costs but also to improve the services available to them.

Experienced, trained personnel

Many local governments have developed an experienced base of telecommunications specialists. This expertise is frequently deployed throughout the various departments in the government. Much is to be gained if this expertise is properly coordinated either through a coordinated management system or through consolidation into one organization.

Access to 'Right of Way'

Another valuable resource that is often ignored is a local government's access to local *right of way* conduits. Historically these *right of way* paths along streets or through government owned or controlled property have been used for a variety of purposes including electrical power grids, traffic light systems, fire alarm systems, and sewer-water systems. Today with the availability of fiber optic cabling technology, requiring very little conduit space, it is possible to use these *right of way* conduits for telecommunications systems. This is especially viable since fiber optic systems have become an inexpensive, highly reliable, alternative for high bandwidth communications requirements.

Access to *right-of-way* enables the Municipality to install and use telecommunications facilities at minimal expense and effort. Thus, the Municipality can have access to services not commonly available to other users.

Facilities and Buildings

Local governments also have control of many of the buildings and facilities in which the various departments are housed. As a result, the installation and maintenance of private telecommunications systems such as PBXs (in basement facilities), radio transmitters, and microwave towers (on building roof tops) becomes very possible. This environment makes it possible for local governments to deploy and manage their own telecommunications systems and provide most of the services required by the users.

Local governments also have many intrinsic disadvantages that have to be taken into consideration.

Lack of Awareness

There is a lack of awareness at senior administration levels within the government environment as to the critical importance of telecommunications. This problem is founded on the perception of telecommunications as a back-office function, and it persists both in the user community and the management/political hierarchy. Lack of awareness frequently translates into a lack of funding support for telecommunications.

Failure to Coordinate Telecommunications Systems and Development

The failure to coordinate telecommunications services is rooted in the fact that telecommunications is managed by many different departments within a municipality. For example most telecommunications expenditures tend to be spent to meet immediate requirements. Services are bought from vendors on an as-needed basis by the various departments. However these purchases are not coordinated and the municipalities buying power is not taken advantage of. Furthermore these systems tend to be incompatible and counterproductive in the long run. If properly coordinated through purchasing policies and technical standards it is possible to purchase and install communications systems that would be both compatible and cost effective in the long run. Organizations with telecommunications responsibility have to develop the coordination and the foresight necessary to implement systems that become a part of the entire municipality's telecommunications infrastructure.

Ineffective Use of Telecommunications Expertise

Much of the expertise in telecommunications is distributed throughout the many departments of local government. Individuals in each of these departments tend manage towards the needs of only that department. Furthermore the municipality as a whole does not receive the benefit of their expertise.

Absence of a Telecommunications Master Plan

Most of the issues discussed above could be addressed by developing a telecommunications Master Plan. Many local governments do not have a properly formulated plan that addresses telecommunications. This again may be the result of a distributed telecommunications management structure. No central organization is responsible for telecommunications planning. As a result, the government's ability to grow its telecommunications capabilities becomes limited.

A considerable amount of effort and activity is expended in dealing with day to day maintenance and management problems while the long term planning requirements go forgotten. As many of their private sector counterparts are learning, telecommunications planning is a vital and valuable activity. In fact, a properly formulated telecommunications plan helps focus day to day activity while building towards a growing municipal infrastructure.

STRUCTURAL CHALLENGES

These comments are based on our analyses of the municipalities of the City and County of Honolulu, City and County of San Francisco and the County of San Mateo.

Multiple Organizations / Departments and Entities

By the nature of local municipal governments they are divided into several branches to preserve the separation of legislative powers and be

responsive to their constituents. This creates the Administrative, Legislative and Executive branches of government including a public safety organization. Each arm of the municipality has different telecommunications needs and because of the separation of powers may develop and support their own telecommunication systems.

Many Organizations Provide Telecommunications

In the municipalities we studies, there are several agencies that manage and provide telecommunication services. Generally these agencies have responsibilities for other functions besides telecommunications:

- Electrical Systems - Department of Electricity
- Data Systems - Department of Data Systems
- Building / Facilities - Buildings Department
- Public Safety - Police, Fire, Ambulance etc.

Due to their expertise in these fields, or in the case of Public Safety, due to the extraordinary need for telecommunication services these organizations have historically managed some portion of the municipality's telecommunications system.

Department of Electricity - The agency responsibility for electrical systems has historically provided electrical services including wiring and electrical system maintenance. Since telecommunications systems also require some similar skills, the department of electricity has inherited some of the responsibility for telecommunications.

Department of Data Systems - The agency responsible for data systems has the primary responsibility of providing data processing and data communications services to the other municipal departments Although data processing requirements have always been high, data communications requirements have been minimal up until recent years. However, as some data-related applications, such as Geographical Information Systems (GIS) and Database programs, have increased the demand on data transmission these departments have taken on more responsibility for telecommunications. With the addition of new applications and the growth of PC based systems, the need for data communications facilities will increase significantly and the data systems departments will take on an even greater role in telecommunications management.

An area that will be especially impacted is the Local Area Network (LAN) interconnect capability. As many users migrate to PC based LAN systems, interdepartmental or interLAN communications will require significant telecommunications capabilities. The Data Systems department in many local governments are currently facing this challenge.

Building Department - Agencies responsible for the buildings and facilities often provide voice telecommunications services. Since telephone systems (voice communications) have historically been viewed as a facilities utility, Buildings departments have developed considerable expertise in this area. Today, voice communications is still the backbone of Municipal operations. Voice services often include the management of telephones, PBXs and Central office services. The Buildings department is also responsible for the installation of premises wiring, telephone sets, number assignments, moves, adds, and changes etc.

Public Safety - Public Safety agencies also support many of the local government's telecommunications services. Public safety requirements for telecommunications services are varied and complex. Emergency call-in, response, dispatch and patrol functions of public Safety agencies (ie: police, fire and ambulance) require significant telecommunications capabilities. These agencies have routinely provided and supported many of these systems including radio, paging, mobile communications and 911 emergency.

External Telecommunications Providers

In addition to Municipal departments that support telecommunications services, the following *external* entities also provide telecommunications services to the Municipal user community:

- Local/regional Telephone Company
- Long Distance Telephone Company
- State Governments
- Equipment Vendors

User Environment

To assess how voice and data telecommunications is used by local governments one has to understand the flow of information within the user environment of government entities. Generally the following six types of communications are present in a municipal environment:

Between Floors within a Building - Departments may occupy more than one floor in a building. Individuals in the same department on separate floors need to communicate with each other. In addition, individuals in separate departments need to be able to communicate with each other.

Between Physical Locations - There are many buildings and locations in a Municipality distributed over wide geography. The ability to communicate between physical locations is required in order for the departments and the Municipality to conduct its business.

Between Physical Locations and Vehicles - Public safety organizations, police, fire and ambulance dispatch centers must be able to communicate with their respective vehicles and stations for public safety and business needs. In addition, the Municipality has various agencies, such as Public Works, Parks, and Building which use this form of communication.

Between Physical Locations and Individuals - Examples include the usage of portable radios or cellular phones by Municipal employees to communicate with their dispatch or supervisory location.

Between Vehicles and Vehicles - This includes the public safety functions of police and fire vehicles along with the various Municipal maintenance or service vehicles.

Between Vehicles and Individuals - This includes the public safety functions of police and fire vehicles and personnel along with the various Municipal maintenance or service vehicles and personnel.

External Communications

Local governments have the need to communicate with many agencies outside the municipal government. Our review of a Municipality's external communications needs, determined that it maintain communication with the following:

- State Government
- The Judicial system
- Federal Government
- Business Community
- Public (Constituents)

A majority of the above current external communications is provided by voice transmission. However there are exceptions, for example in the City & County of Honolulu, Municipal environment specific external data connections include direct data links to both the State and the Judicial Computer Centers. External data links also exist for the NCIC application in San Francisco, New York, and Washington DC., NLETS Application in Phoenix, and the IBM Information Network (IIN) in San Francisco for the Commercial Drivers License Application (CDL).

More data-intensive external data interactions have been limited due to the unavailability of specific applications and the lack of a telecommunications structure to support them. These may include video conferencing, GIS data, land use, and other document storage and retrieval applications

TECHNOLOGICAL CHALLENGES

Increased need for internal communications

The Municipality has extensive voice, data, and radio networks to provide internal communications requirements. A majority of the current Municipal communications is voice transmission; however, there is a growing demand for data transmission between locations and vehicles. An example of the growing data demand can be illustrated by the Police Departments, which are evaluating the feasibility of providing patrol cars with mobile data terminals. In addition, there are many growing data applications, such as GIS, image processing, video conferencing, and Electronic Mail (E-mail) that are contributing to the growth in data transmission needs.

Voice and Data Transmission Requirements

Currently, the largest requirement for telecommunications support in the Municipal environment is for voice transmission. The largest need for data transmission is sending administrative data to departmental and end-user systems. Data transmission is also required to support personnel, accounting, inventory, and other administrative functions, tax administration, electronic messaging, and teleconferencing. Representative examples of functions generating telecommunications traffic are provided in the following paragraphs.

The fulfillment of the Municipal governmental responsibilities requires exchanges of data among departmental systems and end users. Data to be exchanged may consist of individual data elements, groups of cases, large data bases, or software files. The first two types of data need to be available on a real-time basis, while the large data bases and files may be downloaded during off-peak hours.

Departmental Data Transmission Requirements - Departmental systems download subsets of data from departmental data bases, maintain special purpose data bases, process information for local users, and provide access to large data bases.

The departmental requirements for the telecommunications architecture are as follows:

- Ability to connect workstations to local file servers or minicomputers and other Municipal common applications via local networks
- Ability to retrieve data from other systems
- Ability to transfer files between Municipal systems and departmental systems

End-User Data Transmission Requirements - End users maintain a variety of programs designed to help perform special jobs, such as auditing, budget tracking, and report writing. End users will need to retrieve data on departmental computers and send data to other users and shared output devices, such as printers and file servers.

Administrative Requirements - Estimates are that administrative functions may generate at least 20 to 30 percent of the total telecommunications requirements. These functions include personnel actions and payroll, inventory and supplies, procurement, travel and training records, and forms distribution. Some bookkeeping records are sent as file transfers for batch update of files, but on-line inquiries require interactive telecommunications among all levels of the Municipal offices. Other administrative functions that must be supported are Office Automation (including word processing, spreadsheets, data bases, graphics, and project management) and

entity-wide electronic mail services.

Data Traffic Volume - The largest volume of data telecommunications occurs on the local networks as minicomputers, file servers, and workstations exchange data throughout the day. The largest file transfers occur between departmental systems.

Image Transmission Requirements- Images are a special type of data. A digital image/optical disk storage system is a process of scanning documents, compressing the resulting bit streams by deleting blanks and repeated characters, and storing the images temporarily on magnetic disk and then permanently on optical disk or similar media. The data images can be retrieved at will from a central file, and transmitted over telecommunications lines, as file transfers, to a remote workstation for viewing.

The impact on telecommunications due to digital image storage and retrieval is anticipated to be noticeable despite the advent of compression techniques and the ability to transfer files to a local processor during off-peak periods, using the same network paths and protocols provided for character data. Image transmission would most likely use existing network paths but would require greater capacity than is currently available.

Video Requirements - Video requirements are expected to become more prevalent, as commercial video services become more cost-effective. For example assuming such services are proven cost-effective, video teleconferencing will probably be required by municipalities for providing interaction within the current core of municipal offices.

Large Informational Data Bases

If municipal governments are viewed as large repositories of data, then the automation of the retrieval and dissemination of the data would provide increased efficiencies. These efficiencies would allow the municipalities to provide a higher level of service and support increased work loads with out the addition of personnel or other expensive resources.

Municipal governments maintain large data repositories of information which include:

- Hearing / Meeting transcripts
- Tax assessment information
- Title search information
- Permit information
- Registration information
- Geographical Information
- Legal information
- Community Service information

Information Access as a Revenue Generator

These informational data bases are also of value to the general public and to the local business and legal communities. This information becomes useful if it is accessible electronically. As such, municipalities could potentially provide this information at a nominal charge to interested parties.

For example, the local legal community would have interest in accessing court calendars over an electronic access network. Other information access examples would include, public access to tax information, real estate industry access to title information, tourist access to calendar events etc.

Providing access to this information translates to direct revenue to local governments. This revenue could be applied to further improve telecommunications capabilities.

CONCLUSION

As discussed in this article local governments will have a significant challenge ahead of them if they are to keep up with telecommunications technology and demand.

Municipalities need to recognize that there will be unprecedented growth in telecommunications requirements. This will be as a result of internal information exchange and external interfaces to meet public demand for information. To date this information demand has been partly stemmed by paperwork and the slow processing of requests. As the common public becomes more computer literate the demand for electronic information will grow exponentially. This demand could range from title searches to requests for transcripts of recent hearings etc. Municipalities have to be prepared to deal with the telecommunications impact of such demand and eventual usage by their constituency.

To meet the demands for the future, it is important that local governments take the challenges discussed in this article into consideration while developing a management strategy for telecommunications and meeting further informational needs. Some of the steps necessary to arrive at a workable solution include:

- Develop a telecommunications master plan
- Develop workable standards for networking
- Coordinate telecommunications related activity throughout the organization
- Leverage the installed base of facilities, equipment and services.
- Develop and enhance the existing telecommunications expertise within the different organizations.
- Increase awareness within the user community and the management hierarchy.
- Plan telecommunications deployment as a long term investment and build upon the infrastructure.
- Provide access to public information and potentially generate revenue.

These steps are a precursor to arriving at a manageable solution. It should be recognized,

based on our analysis of the City & County of Honolulu, the City & County of San Francisco and the County of San Mateo, that municipal governments are a complex environment, each with its own special needs and idiosyncrasies. As such, each environment has to be assessed separately and an appropriate plan to deal with telecommunications has to be developed. If properly planned and implemented, both the Municipality and its constituents stand to gain significantly in the long run.

We would like to thank our clients at the City and County of Honolulu, Hawaii, the City and County of San Francisco, California, and the County of San Mateo, California for their support in preparing this paper. Ideas expressed in this paper are those of the authors and do not represent views of the respective government agencies.

INFORMATION TECHNOLOGY AS AN EMERGING PARAMETER IN REGIONAL PLANNING

by

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Information technology products and services are the sinew and tendon of modern commerce. Government planners and academics have characterized the deployment of information technology products and services, and the resultant information economies, as the advent of the information society. Yet, when one examines the literature of urban and regional planning, there are few, if any, references to information technology as a planning parameter. While planning for information technology products and services may remain a silent variable in industrialized countries, for those nations without an industrial base from which to create an information society, methodical consideration of how to optimize information technology resources is critical. To advance the theory that there should be more consideration of information technology in planning the leap from pre-industrial to post-industrial society in such countries, the author discusses one perspective on the use of information technology as a parameter in regional planning.

I. INTRODUCTION

How should the work and residential requirements of service and information workers for information technology infrastructure shape urban and regional planning? U.S. and Japanese literature is voluminous in its discussion of the information, or informationalized, society (in Japanese: *joho shakai*, *johoka shakai*, or even *enha joho shakai*), but little has been published on information technology as a parameter in urban and regional planning. Although the literature concerning intelligent buildings and technology parks is somewhat related, these articles focus primarily on the building layout, the sizing of conduits, surveillance and security systems, and other architectural topics. Between the subterranean discussion of conduits and the stratospheric discussion of the information society, an important policy issue has gone begging: what information technology products and services should be developed to promote economic development of a city or region in non-industrialized nations?

It is understandable that information technology should be a silent variable in urban and regional planning within industrialized countries: the industrial sector in these countries gave birth to the information economy. Financial, marketing, and management information processing has supported the purchase of successive generations of computer, voice, image/video, LAN, WAN, and now MAN and multimedia products and services. Roads, water, wastewater, conduits for electricity and telecom, but not information technology per se, have been the regional planning design issues. Although market forces in industrialized countries may obviate the need for governmental or developer planning for information technology products and services, such is not the case in non-industrialized regions.

Non-industrialized nations are usually characterized by fuel and other resource scarcity and few hard currency exports. Many non-industrialized nations have diminishing, or very cyclical, agricultural export earnings, may desire (or are forced by circumstances) to "bypass" significant industrialization, and look to a service economy, especially tourism, for economic development. Although recognition of the financial and environmental advantages of service economies is widespread, planners working for governments and developers usually fail to recognize that a service economy is by definition an information economy and is therefore based on information technology products and services. Such planners are unaware that successful development of a service economy cannot occur without concomitant planning and development of information technology products and services.

The premise of this paper is that planning regional development in non-industrialized countries must go beyond consideration of cable plant, central offices, cable landings, and earth stations; planning a service economy must include the description of the information services to be provided and the hardware and software on which these services will be created and grown.

II. TOURISM AS THE TEST CASE

Most, if not all, Pacific Island nations look to tourism as the best, if not the only, means of substantial economic development. There are few alternatives. In some Pacific nations, fisheries provide several million U.S. dollars a year of income. Usually, this means selling fishing rights to foreign fishing fleets, however, not a domestic fishing industry. The fresh fish, cut flower, aquarium fish, or other high margin industry languishes in many Pacific nations for lack of a reliable means of transportation of perishable products to markets in industrialized countries. Tourism, and the reliable air transport that tourism brings, solve two major problems: bringing hard currency into the country through tourists' spending, and exporting perishables to foreign markets.

Tourism to Pacific Island nations (as well as to many rural areas of Asia) has traditionally been the domain of the adventurous individuals, known in the travel industry as free independent travelers ("FIT"). FITs will tolerate lack of (or seek to avoid) telephone and fax service, television programming, day tours, Western-style hotel rooms, reliable air service schedules, and other services that less adventurous travelers, such as group inclusive travelers ("GIT"), require. As a rule, FITs are fewer, spend less, and arrive with less predictability than GITs. Obviously, Pacific Island nations must attract GITs to build service economies. Attracting and retaining a GIT visitor base has many implications for information technology products and services, however. These implications can be broadly categorized as guest communications, supplier communications, and intermediary communications.

Guest communications start with a guest's inevitable call home after checking into accommodations (hotel, bed & breakfast, etc., generally called the "property"). This means international direct dialing from the guest room, or at least from the property. A phone booth off the property is not acceptable to the many GITs who venture off the property only with the tour group. In addition to voice communications, GIT escorts desire fax service on the property, especially if the time zone of the property is very different from the home country time zone. Business guests, even during leisure travel, also seek fax service and, increasingly, a second line in the guest room for modem or fax/modem use. If a property wishes to market itself as more than leisure traveler accommodations, a quantum leap in information technology is required. Even small business meetings, such as management retreats, commercial seminars, and smaller conferences, attract guests who are accustomed to sophisticated information technology services, such as voice processing, PC rentals, A/V systems, e-mail and online services, and videoconferencing.

Supplier communications are basically of two types: property procurement related and guest support. Property procurement related communications involve obtaining supplies and labor to support property operations. Guest support communications involve dialogs between guests and off-property suppliers of consumer products (especially souvenirs), entertainment, day tours, and dining. "Supplier communications" refers to the fact that suppliers, including local businesses near the property, must have telephones. This is not always the case in non-industrialized countries.

Intermediary communications are primarily reservations systems, preferably computerized reservations systems. Although international airlines all use computerized reservations systems, most property reservations systems in non-industrialized countries are still limited to mail, telephone, and, increasingly, fax. Intermediaries, such as travel agents and tour packagers, must deal directly with properties, airlines, and other travel service suppliers. By dealing with a travel agent or other intermediary, a GIT traveler is screened from the frustrations of non-computerized reservations systems.

The travel agent, however, may steer clientele toward properties and suppliers that have computerized reservations systems, however, to avoid spending inordinate time arranging and rearranging an itinerary by phone and fax. The rapidity with which properties and other suppliers can be checked for availability, reservations made, and confirmations received are probably the highest priority guiding travel agent behavior. Ceteris paribus, only if a client insists on using a supplier without a computerized reservation system will a travel agent do so; in such cases, the agent has a defense if the "confirmed reservation" is otherwise.

Also included in intermediary communications are marketing products, especially audiovisual programs, produced by property owners, local suppliers, tourism promotion agencies, and others for use by intermediaries in attracting travelers. Audiovisual products for intermediary communications now include multimedia presentations on laserdisk and CD-ROM.

III. FUNDING I.T. PROJECTS

Building a tourism-based economy requires planning and providing a basic level of information technology services for guest, supplier, and intermediary communications. Competing for meetings and convention business requires a level of information technology sophistication equal to that in the U.S., Japan, and Europe. Generally speaking, ministers of tourism in non-industrialized nations also have other portfolios that usually present higher priorities for immediate use of available hard currency than information technology. Even if these ministers, their peers in cabinet, and the prime minister appreciate and plan for the type and amount of information technology products and services required for economic development, there are often no funds to purchase such products and services.

This author suggests that the funding of information technology infrastructure, products, and services can be accomplished as part of an expanded development agreement with parties proposing to construct hotel properties or other real property improvements. In such a development

agreement, the host government would agree to a lower revenue to government (whether by tax rate, commissions, lease rent, etc.) in exchange for the developer's installation of "oversized" computer and telecom equipment and an off-property VSAT earth station and remote telecom switch. The "normal" capacity of the computer and telecom equipment would be used for basic guest communications and a computerized reservations system for the property. The "extra" capacity in the computer and telecom equipment would be used for supplier communications. Under the development agreement, the developer would construct cable plant connecting local suppliers with the remote telecom switch. International communications would be via digital VSAT services. Either government or contract staff would maintain the VSAT equipment and remote telephone switch. If the developer were not building hotel or accommodations, the remote telephone switch would serve nearby hotel or other properties in addition to suppliers.

Using this approach, digital communications could be provided to properties and basic telephone service to local suppliers (and residences). Digital communications hardware would permit not only the basic services, but would avoid investment in analog equipment and enable videoconferencing and other business guest services equal to those in the industrialized countries.

A CRITIQUE OF AMERICAN INFRASTRUCTURE NETWORK PROJECTS TO GUIDE EFFORTS TO SUPPORT SOCIAL VALUES THROUGH NETWORKING

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ABSTRACT

During the last several years, the American telecommunications landscape has blossomed with comprehensive computing and/or communications infrastructures created as a result of the partnership between the public, i.e. government, and private, i.e. business, sectors. This paper will highlight social implications as a follow-up to the authors' previous work. As a result, it is expected that others, namely other state and provincial governments as well as other countries, can learn from these experiences so that their benefits can be replicated at lower financial and political cost and in more timely fashion.

INTRODUCTION

There is little doubt that increased attention to interpersonal relationships, increased communication, and increased use of consensus decision making are current trends in business.

Evolving trends in organizational structure have ramifications for communication.

As the role of communication expands, the role of information technology in promoting communication is fostering experimentation in organizing work and in management practices. (Butera & Bartezzaghi, 1983; Short, Williams, and Christie, 1976) As an example of a new way of organizing work, tele-commuting no longer requires people to go to an office to go to work. (Cross & Raizman, 1986)

INFRASTRUCTURE NETWORKS

An infrastructure network is a telecommunications network that provides basic communication services on which public, e.g. government, or private, e.g. corporation, organizations depend for their survival. Mears (1974) defines a communication network as "the interaction required by a **group** to accomplish a task." Mears (1974, p. 71) states:

> An organization's effectiveness depends upon the performance of numerous small **groups** which function and interact within the overall organizational system. Since the activity of a small group depends to a great extent upon its information flow, the **communications** act has been studied as a means of influencing efficiency.

An infrastructure network is distinguished from any ordinary communications facility because it is both pervasive and comprehensive to promote group participation! An infrastructure network provides the foundation upon which value-added (beyond merely transport and switching) information services can be exploited for competitive advantage or for service improvements. For example, tele-commuting requires considerable value-added services such as office automation to support calendaring and other functions necessary to support a mobile work force. Electronic mail is another value-added service that requires an infrastructure network to provide connectivity and accessibility across the twin barriers of time and distance. (Rice & Case, 1983)

Case studies have demonstrated that most benefits derived from information technology improve intragroup communications. (Strassman, 1985, p. 43)

However, a critical mass of connected workstations must be achieved to enable a group to try new ways of organizing work! It is necessary to construct networks of considerable scale in order to achieve major improvements in office communications.

An infrastructure network consolidates the communications requirements of virtually all of the organization to achieve economies of scale. (Ho, 1987) An infrastructure network complements the public telecommunications network by providing a more robust and complete infrastructure in either the public (Ho, 1987) or private (Estrin, 1987) arena. As Kling and Scacchi (1982) point out, good infrastructural resources are essential for the smooth deployment and routine operation of any information technology.

The pervasiveness and comprehensiveness of infrastructure networks enable powerful communication services such as:

1) Video communication is especially effective in motivating employees and in communicating social and organizational values.

The contribution of videoconferencing to horizontal and diagonal communication that enable non-hierarchical links has been documented by Dutton, Fulk, and Steinfield. (1982) Furthermore, a variety of consensus-building activities that involve group decision-making were also reported.

Video communication consumes large amounts of communication capacity that require the robustness of infrastructure networks.

2) Gateways to other networks promote communication with other organizations so that one can gain access to other resources such as education provided by trade groups or third-party vendors.

The influence of gateways on communication patterns of people and organizations has been discussed by Estrin. (1987) Gateways are expensive to develop and to maintain so that they are most easily justified when they are shared by many users that are supported by an infrastructure network.

3) Value-added services include the variety of office automation tools such as electronic mail that will improve communications.

More powerful tools such as computerized conferencing (Hiltz & Turoff, 1978) that support group decision-making require even more communication capacity. Gordon Thompson (1972) has identified three criteria that characterize the communications revolution made possible by infrastructure networks:

1. It will ease the access to stored human experience.
2. It will increase the size of the *common communication space* shared by the communicants, and therefore increase the amount of shared information and interaction among them.
3. It will increase the ease with which new ideas can be developed and spread throughout a society.

Hiltz and Turoff (1978, pp. 469-472) have claimed that computerized conferencing ranks highest according to these criteria when compared against less robust communications alternatives, e.g. books, telephone, face-to-face, and TV.

Background

INTELENET

INTELENET (INdiana TELEcommunications NETwork) is an initiative of Indiana state government. INTELENET (Ho, 1987) merely provides transmission and switching services for Indiana government and education. INTELENET is an infrastructure network on which all other value-added networks would depend for basic transmission and switching services. As such an infrastructure, INTELENET is similar to the public switched network provided by common carriers. With respect to regulatory/policy issues and finance and economics, it differs from the public switched network. INTELENET is owned by GTE Telecom, an unregulated subsidiary of GTE, and leased by the INTELENET Commission, a body corporate and politic, created by Indiana state statute. The INTELENET Commission resells transmission and switching services to Indiana government and education as defined by the INTELENET statute.

NYSERNet

NYSERNet (New York State Education and Research Network) is the NSFNET's regional mid-level network serving New York education and business. NSFNET (Quarterman, 1991a & 1991b) is the main backbone network in the Internet. The Internet is the successor to the former ARPANET serving the U.S. government's Defense Research Projects Agency. The array of networks now consists of three tiers (Mandelbaum & Mandelbaum, 1991):

1. A national backbone network that connects supercomputer centers and the various regional wide area networks
2. Regional and supercomputer-consortia networks, e.g. NYSERNet, BARRNet (San Francisco Bay Area Regional Research Network), and SURANet (Southern Universities Research Association Network)
3. Campus networks, i.e. internal local area networks serving a single academic or industrial campus.

The first two tiers constitute NSFNET. NSFNET is not a network; it is an inter-network, i.e. a network of networks.

K-12 Networking

The phenomenon of providing Internet access to the K-12 (kindergarten through 12th grade) community provides exciting examples of infrastructure networks. The EDUCOM K-12 Networking Project (Clement, 1991) aims to link together primary and secondary education through computer-mediated communication networks. In this way, the project will develop network-using resources to support curriculum reform and institutional restructuring. EDUCOM can be contacted at:

1112 Sixteenth Street, N.W.
Suite 600
Washington, DC 20036
USA
Phone: +1 202 872 4200
Fax: +1 202 872 4318
Bitnet: jrc@bitnic
Internet: clement@educom.edu
AppleLink: educom

The Consortium for School Networking represents a national effort to establish the "K-12 network" in the United States. Related efforts in Japan include the Association of Global Electronic Networking Educators:

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CompuServe: 74070, 305

An example of a local initiative in K-12 networking is "Common Knowledge: Pittsburgh" to provide Internet access to all teachers and students in the Pittsburgh public schools and to begin to integrate this new technological resource into the existing school curriculum.

The history of this initiative goes back more than two years when Professor Robert (Bob) Carlitz of the University of Pittsburgh's Department of Physics and Astronomy began to investigate the possibility of extending Internet access to the K-12 community. In connection with this exploration, Bob created an Internet mailing list called KIDSNET that now reaches around the world.

As teachers in Pittsburgh have gained access to the Internet (mostly through the University of Pittsburgh), they have discovered resources such as the NASA Spacelink or the Cleveland Freenet or have established international exchanges with other classrooms worldwide. As we have worked to develop a project which can reach all teachers and students in the Pittsburgh public schools, we have made an effort to structure the project so as to maximize its potential classroom benefits. We are attempting to build a support network that has the breadth to reach all teachers and the depth to accommodate people at all stages of familiarity with this new technology.

Curriculum support will come from the existing mechanisms for developing and implementing the school district's curriculum. Among the projects that are currently being discussed are the following:

1. Industry tutors for students developing science projects
2. International exchanges with schools in Asia and Europe
3. Identification and cataloging of regional habitats including urban neighborhoods and city/state parks
4. An interactive library card catalog
5. Development of writing skills through exchanges of letters

Many of these activities are already taking place. All have the characteristic that they may be easily extended to involve children, teachers, and professionals outside of a given school - and even outside of Pittsburgh, Pennsylvania, or the United States. This extensibility is the greatest strength that the Internet has to offer.

There is another aspect of the Internet that is significant. Already, the Internet reaches all of the research universities in the United States, Europe, and Japan as well as hundreds of companies. As this connectivity increases, one will be able to tap some of the resources latent in these organizations. More people will become active in the schools by dropping in electronically for a little while every day. In a similar fashion, students will leave the confines of the classroom and make electronic visits to museums, libraries, businesses, and governments around the world.

There will be many concrete benefits that one can expect from such a network. In terms of educational issues, the following problems can be attacked:

1. Isolation: The current isolation of the classroom teacher would be largely reduced by such a network. Teachers could easily communicate with their peers, their supervisors, and experts in their fields of specialization.
2. Access to information: This need is most obvious in the sciences where entire disciplines are redefined in a decade or less. Nevertheless, it is relevant to all fields and to the general intellectual vitality of the teaching environment.
3. Equity: Network resources are **shared** resources. A network which reaches all schools carries all information that is made available on the network to all of these schools.

The Consortium for School Networking seeks to spread this phenomenon throughout the entire United States. Those states which choose to encourage the development of this activity will have the opportunity to establish themselves as leaders in this field. It is a field which knows no national boundaries so leadership in this field means leadership in a major international activity.

For this reason, the project seeks to build a sphere of "Common Knowledge." This phrase refers to both the idea of a shared body of information such as we would want our schools to teach our children. And it refers to the idea that we would want all people to share this information - that it should be common knowledge for everyone.

Information services initiatives

The removal of the information services ban on the Bell regional holding companies puts the spotlight on initiatives related to information services. Among these initiatives, Hawaii INC (Hawaii Information Network Corporation) encourages the creation of information providers. A "grass roots" effort to promote economic development and to improve quality of life through telecommunications and information technology is POINT 21 (Pittsburgh's Opportunity In New Telecommunications for the 21st century) that has conceived a Regional Information District to serve southwestern Pennsylvania.

The Regional Information District would provide a mechanism for businesses, schools, nonprofit groups, and governmental agencies to share information resources. The Regional Information District would benefit all participants. Specific instances would include the following:

* New information resources for the schools
* Improved workforce for businesses
* Efficient information delivery for governments
* Good environment for information-related businesses
* Model schools for the information age

Full implementation of the Regional Information District would involve network connections for all government agencies, businesses, nonprofit organizations, and schools in the region. Development of such an extensive network would take several years - perhaps until the end of the decade. In the near term, one could build upon existing networks and provide incentives for the extension and interconnection of these networks.

For example, take university networks and the Internet as a working model. Connect model school districts to the Internet and begin to develop educational materials through model projects. Allow businesses to connect to the Internet at low educational rates if these businesses agree to provide either mentors or some educational materials through their network connections.

Develop model projects involving nonprofit groups, e.g. libraries and museums. Fund these projects through grants developed in connection with the model school districts. Develop an agency, i.e. Regional Information District, to facilitate the networking of nonprofit groups. Nonprofits could contract with this agency for network services and advice. Funds raised through this mechanism could sustain the operation of the agency. Another agency could be established to guide the development of educational materials for the model school districts. This agency could be funded through grants which support the local model school districts and through paid services provided to other school districts around the country. The America 2000 program provides a mechanism of this sort which could be exploited to help fund this agency.

In this way, the community would gain first-hand experience in the delivery of information services as well as in the development of computer-based educational materials, two emerging industrial sectors.

OPPORTUNITIES FOR NEWLY-INDUSTRIALIZED NATIONS IN ASIA

In an earlier paper, we (Ho & Sung, 1990) claimed that infrastructure networks represent a vital opportunity for newly-industrialized nations in Asia. In these nations, through effective communication, social values related to the "group" will produce a better payoff. This payoff would result from the momentum and partnership experience generated by recent economic success. Also, the relatively smaller size of these nations would enable easier networking. Finally, as demonstrated by their success and as a result of their smaller scale, the ability of these nations to focus on what needs to be done will insure the wise investment of funds earned from economic success in projects that will guarantee future success.

We recommended the development of infrastructure networks including national and local networks as well as gateways (to other national networks) and other network, e.g. data bases, resources. The involvement of all constituencies, government and education as well as the private sector, will encourage experiments with information technology in organizing work and in management practices that incorporate social values.

Asian political-administrative traditions have stressed the desirability of harmony and consensus. A concern for consensus and values related to the group will result in a higher payoff through communication. Furthermore, the momentum and partnership experience achieved through recent economic success can be sustained through communication.

Just as the existence of comprehensive and pervasive infrastructure networks will encourage experiments with communications technology in organizing work and in management practices, these networks will encourage experiments in economic development and quality of life, e.g. educational reform.

Experiments in organizing work to change the concept of work

The impact of information technology on the social fabric of group life is discussed by Kling. (1984) The way in which work is becoming organized requires a new set of skills. (Bernstein, 1988) As companies change from old models of assembly-line production to Japanese-style work teams, employees will have to improve their ability to communicate.

One of the characteristics of a productive organization is that the way individuals are linked together is of greater importance than what any individual does in isolation. (Strassman, 1985, p. 23) Electronic mail encourages collaboration. For example, this paper was produced by communicating via Bitnet, the worldwide academic network (Fuchs, 1983), between the United States and Taiwan. Communicating across time zones and between remote locations creates new organizational opportunities for accomplishing work on a decentralized basis. (Strassman, 1985, p. 44)

Experiments in management practices that incorporate social values

Communications technology can enable the distribution of knowledge throughout an organization. This distribution can then manifest itself in terms of changes in organizational relationships since knowledge no longer remains exclusive among only a few individuals. The result is a more effective organization.

Replicating scarce knowledge can profoundly affect organizational structure and corporate culture. When scarce knowledge is more widely available, personnel at lower levels of the organization, rather than merely senior management, may more aggressively participate in decision-making.

SUMMARY

Networks are indeed capable of creating opportunities for experiments in organizing work and in management practices. These experiments can change the concept of work in ways that incorporate social values that emphasize teamwork. Teamwork is among the social values that have contributed significantly to the economic success of Asia's newly-industrialized nations. For these nations, infrastructure networks that are both pervasive and comprehensive in order to maximize group participation represent a genuine opportunity to capitalize on this situation. Furthermore, these networks can encourage experiments in economic development and quality of life.

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INTERCONNECTING THE PACIFIC

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1. ABSTRACT

The global community is moving to a new era in telecommunications technology and utilization. The people of the Pacific Basin are being bypassed by these developments. It is the purpose of this paper to suggest a model by which the Pacific Islands can begin to participate in the telecommunications revolution. To facilitate the discussion of this model this paper has been organized into the following major sections: (1) Introduction; (2) An Alternative Regional Communications Service; (3) A Model Thin Route Network; (4) Implications of the Regional Network.

2. INTRODUCTION

At the turn of the twenty first century, the Pacific world stands on the threshold of a revolution. Developments in communications, shipping, transportation and production technology herald significant changes in nearly every aspect of the region's life. Several authors have begun to speak of a Pacific era in which the developed nations of the Pacific Rim will assume a leadership role of an increasingly cosmopolitan world society. (1)

Within this revolution, changes in telecommunications technology and computer utilization appear to be having the greatest initial impact. Access to information by countries, corporations and individuals is greater and more reliable than at any other time in humanity's experience. The ease with which information can be accessed and expanded presages cultural, economic and social changes in world society which may prove to be as significant as the Renaissance and the Industrial Revolution. (2)

The potential of these changes has been recognized by a variety of authors and scholars publishing in a variety of different forums and formats. It has led the United Nations to include the following article, number 19, within the Universal Declaration of Human Rights. (3)

> *"Everyone has the right to freedom of opinion and expression: this right includes the freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers."* (4)

Unfortunately, the twenty first century revolution is bypassing the people of the Pacific Basin. Instead of experiencing state of the art modernization of telecommunications service, the island nations of the Pacific have experienced a slow and inadequate expansion of their communications resources that severely handicaps their ability to participate in the modern world. Several significant reasons for this lack of development are: the remoteness of the region; its small population, inadequate infrastructure; lack of natural resources, and limited potential for economic development; the restrictive policies toward non indigenous communication services imposed by the governments of the region; the lack of interest in developing "thin route" areas on the part of carriers based in the nations of the Pacific Rim; and the tendency on the part of regional governments to view high long distance telecommunications tariffs as a necessity to help upgrade their domestic telecommunications systems and to feed development in other sectors of island society.

3. AN ALTERNATIVE REGIONAL COMMUNICATIONS SERVICE

It is the purpose of this paper to suggest an alternative to the present situation. This alternative envisions the creation of a regional telecommunications network that will link the Pacific Basin with an integrated voice, data and video communication services. Such a network will be designed to achieve two immediate goals.

1. It will provide intraisland links within the Basin. These links will allow the peoples and governments of the Pacific to communicate with each other more easily and less costly than has been possible in the past. Given the similarity of the region's cultural traditions and developmental problems, this sharing can help the region to strengthen common ties and cultivate more effective solutions to commonly experienced developmental problems.

2. The network will provide a direct interface for island users with international communications services. For the first time the peoples of the Pacific Basin will have open and equal access to the world's telecommunications resources. No longer will the region be viewed as a backwater cut off from world developments by its remoteness, low population density and lack of technological resources. Such a development will also aid the regions ability to begin solving its developmental problems by bringing the insights of other cultural, economic, political and social systems to bear on the island experience. In addition it will provide island users with a possibility for self enrichment undreamed of in past generations. Businesses locating in and tourists visiting the region will be provided with equivalent communications services to those available in the more developed nations of the Pacific Rim. This availability should encourage economic development and diversification within the region. By increasing the connectivity with the rest of the world, the Pacific Basin will also be able to buffer itself from those outside forces that have controlled its destiny for the past three centuries. For the first time in the modern era the region can begin to contemplate playing something other than a dependent role in world affairs. (5)

4. A MODEL THIN ROUTE NETWORK

The most reliable and cost effective solution to interconnecting the Pacific Basin is to develop a digital satellite network linking through a central hub, the various island nations to each other and the rest of the world. The hub will also provide a communications gateway to other international carriers.

This process was begun in 1986 when PCI Communications, Inc., a Guam based telecommunications company, created the Pacific Data Network, PACNET. This network presently links Guam, the Commonwealth of the Northern Mariana Islands, Hawaii, and the U.S. mainland. It uses existing satellite and where available, fiber optic channels to achieve this purpose. While PACNET does not presently provide communication, voice and video services to the other nations of the Pacific Basin. It does, however, provide a useful example for the establishment of a broader integrated digital communications network for the area. This model would also be applicable for other sparsely populated areas of the world.

An integrated digital network is designed to provide voice, data and video over common digital bearer circuits trunked to one or more gateways with applications provided by derived circuits on a demand or preassigned basis.

Compression will be used to reduce required bandwidth between each point on the regional network. At the gateway, the network will interface with other international carriers utilizing standard signaling and digital interfaces. By providing a variety of services to various global locations through a common gateway, maximum utilization of facilities will be realized.

The network gateway switch will be located so that most international calls through other transit carries will be terminated via cable facilities. Some international traffic and all regional traffic will necessitate a double satellite connection. While this is not an ideal situation, it does provide effective communication, provided digital echo cancelation is utilized. Double satellite toll connections are still standard and accepted in some international applications as well as many of Alaska's remote villages.

A data network utilizing packet switching or frame relay will provide a seamless interface with the other VAN's for international access as required by the users. The Network's seamlessness allows island users to access the major international networks in the same fashion and at similar prices to users in the more developed nations of the Pacific Rim.

International toll switched voice services will be provided on a fixed 16 Kbs Time Division Multiplexed channel and will be allocated on an as needed basis or maintained on a preassigned basis.

Voice packet options have been considered and found not to offer the required quality needed for public switched services. The routes in most Pacific islands will require too few derived circuits to gain a satisfactory multiplication through statistical compression. The cost of acquiring and maintaining a Full Mesh DAMA system with todays technology would not be economically viable for remote thin routes of the Pacific Basin.

The most satisfactory 16 Kbs voice quality currently available is obtained using a frequancy-domain hybrid coding technique known as Adaptive Transform Coding (ATC). At 16 Kbs, most users rate the voice quality as equal to a local call. In addition, ATC at 16 Kbs can satisfactorily pass in band data signals up tp 2400 Bps. (6)

A cost effective and readily available choice for Voice Data multiplexing equipment is the Clarity 8000 manufactured by Pacific Communications Science, Inc. In provides 4 Data Ports, supports up to 8 ATC voice cards and transparently supports 9.6 Group III fax transmission on the voice ports. Its largest drawback is the current lack of a digital interface supporting a DS1 connection between the Clarity and the telephone switching equipment requiring additional Analog-digital-analog conversions. It is expected that hardware updates will soon address this limitation.

Simplex point-to-multipoint broadcast services can be provided utilizing a 64 Kbs or 128 Kbs (if stereo) digital link and 7 Khz audio codecs. This service will have a superior quality to existing analog satellite services.

A 128 Kbs Duplex channel will be available through the network for scheduled assignment between any 2 points for providing a video conference channel. This channel should also be capable of operating at 112 Kbs for direct interface with the DDS services on other carriers. It will be to the regions advantage to agree on the video codec manufacture for regional use to avoid conversion costs as well as to be able to negotiate the most favorable prices.

Equipment Cost Example

Remote Site

Equipment	Estimated Cost
1. Small Switch for interfacing the local public switched network and the regional network	$10,000
2. Answer detection and supervision equip.(if answer detection in not provided by LEC)	$3,000
3. Voice compression equipt.(4 voice)	$14,000
4. Satellite modems (1 for each service)	$9,000 each
5. Solid State C band RF Transceiver	$25,000
6. 4.5 Meter C Band D-1 antenna (a)	$12,000
7. 7 Khz Audio Codec (b)	$7,000
8. Video Codec (c)	$25,000
9. Packet Switch Pad (d)	$10,000
10. Integrated UPS/Generator	$5,000
11. Test Equipment (e)	$20,000
TOTAL for Broadcast and Video (f)	**$158,000** *

(a) This includes a simple tracking mechanism
(b) This would cost $14,000 for a stereo service
(c) This is for a basic fixed camera system. Additional features will add to price
(d) This is needed only if Packet services are supported.
(f) Includes Spectrum analyzer, power meter and TIMS
(g) This price includes one modem for Switched voice, one modem for Broadcast reception and one modem for video conferencing.
* This does not include site or construction costs

Gateway Site

1. Toll Switch	$200,000
2. Voice compression equipt. (24 voice)	$60,000
3. Integrated frame relay, packet, circuit switch	$30,000
4. Satellite modems (1 for each service)	$9,000 each
5. C band RF Transceiver (300 watt)	$96,000
6. 9.1 Meter C Band D-2 antenna (a)	$140,000
7. 7 Khz Audio Codec (b)	$7,000
8. Video Codec (c)	$37,000
9. Packet Switch Node	$30,000
10. Integrated UPS/Generator	$15,000
11. Test Equipment (d)	$40,000
TOTAL For Toll, Data, Broadcast and Video (e)	$709,000 *

(a) G/T 31.7 dB/K at 20 degree elevation
(b) This figure will be $14,000 if stereo service
(c) This is for a basic video conferences system with movable cameras.
(d) Includes spectrum analyzer, power meter, TIMS, waveform monitor, oscilloscope and noise generator
(e) This price includes four modems for Switched Voice, one modem for Broadcast Transmission and one modem for Video Conferencing.
* This does not include site or construction costs

Intelsat has two tariffs that are suitable for use in the Pacific Basin for thin route traffic utilizing the network configuration described above. IBS service would be the best choice for all nonswitched voice applications, however, it is not permited for Public Switched Voice applications. The Intelsat IDR service does not permit the use of 4.5 meter antennas. Intelsat has recently approved digital communications on VISTA service allowing for small antennas at rates similar to IBS. This Digital VISTA service is ideal for switched voice and packet data (assuming packet data is transmitted on a low speed data channel of the digital voice compression equipment.)

Given the low density of communications traffic and the limited number of users within the Pacific Basin, the establishment of one regional network is an effective way to achieve an economy of scale. If each island state sets up its own independent service, the infrastructure and network management costs are significantly higher. These costs will be passed on to the individual and corporate users and will ultimately result in reduced usage. Reduced usage will require the remaining customers to bear even higher costs or it will force island governments, with limited financial resources, to subsidize communications service.

Similarly, the thin route nature of the Pacific Basin communications precludes the establishment of communications half links to each island by the global international carriers unless a prohibitive tariff is applied to the regionals users. These factors limit usage and access to world telecommunications and information resources by island residents.

The establishment of a Regional Network, however, would reduce these problems. Such a network would pool multiple types of communications traffic from a number of different islands and users, utilizing a variety of bandwidths and interfaces. It would interface as a transit carrier directly or indirectly with each of the international carriers providing the island's individual and corporate users full access to world communications and information resources.

By pooling traffic of multiple types, to multiple destinations and carriers, and providing for intra-regional traffic, sufficient usage can be generated to allow most smaller populations to support a terminal site on this network. The cumulative traffic routed through a common gateway to the major carriers (without each one being required to provide dedicated half links) will be significant enough to justify favorable interconnection rates and policies for regional users. (7)

There are several methods by which an island government can participate in the services of such a network. The specific type of relationship that a given island nation would enter into with the Regional Network would depend upon local political and regulatory conditions. It is also possible that the relationship will change over time as the Network expands and increases its services. Whichever option is chosen, the pooling of Pacific Basin communication traffic will permit the development of an economy of scale for the governments and users of the region.

5. IMPLICATIONS OF THE REGIONAL NETWORK

The establishment of cost effective voice, data and video, communications within the Pacific Basin will have a major impact on Pacific island societies. Educationally, it will provide resources to remote island students who have been denied them in the past. Access to audio and video conferenceing and online services will greatly expand the horizons of students and teachers. These services will allow the development of effective distance education courses at all levels, greatly strengthening curriculum throughout the region.

Economically and socially, the Network will provide a variety of benefits. Among these will be such things as: long distance telephone; tele and video conferenceing systems; electronic mail; electronic fund transfers; credit card verification; online purchasing of a variety of different commodities; credit referencing; airline and hotel reservation services both within and without the region; medical consulting services; access to world data bases and online journals for government and business and academic researchers; better and speedier communication between island governments, etc. (9)

It should be noted, that the establishment of effective communication and information systems in the Pacific cannot help but change island cultures and societies. As new and better methods become available to island residents, and as islanders come in contact with different cultures and value systems, the societies and cultures will change.

This change will be especially significant within the areas of education and access to information. On the one hand the development of effective distance education programs and local access to the world information system may lessen the negative effects of modernization. Families and the local economies may suffer less disruption because of individuals removed from them to secure an adequate education. Sharing information and knowledge between islands and with the rest of the world should aid in problem solving, cultural preservation, and mitigating the negative social, economic and political ills associated with development.

On the other hand, Pacific island cultures have traditionally viewed knowledge, information, and skills as the private possessions of individual clans/lineages. To a certain extent traditional systems of authority and status have been based upon and reinforced by their elites ability to limit access to information and education within their social systems. Similarly, the cultural and linguistic integrity of the Pacific Basin has depended upon the region's remoteness, isolation and its inability to easily communicate with the rest of the world. Open and easy access to information and communications by the general population may necessitate a revision and change in traditional authority and status relationships.

6. CONCLUSION

The creation of a Regional Network which provides increased access to information and modern educational programs to islanders, who have not had access to these systems in the past, will change the region's political, social, economic and cultural systems. While the precise nature of these changes remains to be seen, it is becoming increasingly clear that some realignment in authority relationships might take place and that regions cultures and languages will come under increased pressure for change within the next decade. To minimize the negative aspects of these changes, regional governments and the Regional Network will have to work together to develop controls that will allow change to take place without rending the Basin's traditional social and cultural fabric beyond repair.

7. ENDNOTES

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Two Communications for Global Harmony and Linkage

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ABSTRACT

The deregulation of the Japanese telecommunication market, and the initiation of a competitive framework, took place in a very short time without the MPT having complete information or understanding of the market. Not surprisingly Japanese telecommunication companies are fighting to overcome a number of obstacles, specifically regulatory problems concerning monopoly status and information disclosure requirements, as well as technology issues.
A global shift from an economy of scale to an economy of coverage, to an economy of networks is occurring. Network businesses integrate both an economy of scale and an economy of coverage. The networks must be global, efficient and transparent.
How do I forecast the future?

Introduction

Today's world is growing smaller and smaller. Borders are breaking down, people are communicating by way of various telecommunication tools, such as telephone, electronic mail, facsimile, video conference through satellite and optical fiber links,and geographical differences are almost nil due to the advancements made in the field of information technology. A global society is being developed through various means, but because I sincerely believe that in order to build a truly global society, two types of communication are essential, namely, cross-cultural communication and information technology communication. Cross-cultural communication is the type of open-mindedness and communication that allows peoples from different cultures to understand the meaning of the messages they are sending to one another. And information technology communication is the means by which people all over the globe can communicate more timely and effectively.

Today I would like to talk to you about the revolutionary telecommunications industry, its impact on our global society, its development in Japan. and what I believe are the future trends of this dynamic industry.

I. New Classifications of Industry

In the traditional classifications of industry introduced some fifty years ago by Professor Clark, there were three types: the primary industry for agriculture and mining, the secondary industry for manufacturing and the tertiary for the services industry. Because of technological improvements and economic advancement leading to high and sophisticated consumer demand, I believe that the old classifications are no longer feasible; they relate to the supplier or producer class of industry, while present day economy is more related to the consumer. Thus, in order to better define our economic world, the classes of 1st, 2nd, and 3rd, will be replaced by the 4th, 5th and 6th industry classifications as described below:

The fourth industry is the information industry, which encompasses the use of information and information technology to manage relations between people (ningen), spatial relations (kukan), and time relations (jikan). In other words, information technology is the bridge between persons, space and time. The information industry supplies information data which might simply be called content as well as the means of transmission and process of the content, namely, hardware, software and service.

The fifth industry is the lifestyle industry, or "high touch", including the satisfaction, discipline and autonomy of human beings, particularly in the fields of housing, fashion, dining, health, culture, entertainment and leisure, including sports. Nowadays, it is "trendy" to be time rich, having enough time to enjoy life; health rich, in good health; mobility rich, with enough time and money to travel; and design rich, with money and fashion sense.

The sixth industry is what I call the spiritual industry, or religious industry, in the narrow sense of the word. This means ethics, morality and the meaning of life. These can be provided by traditional religious groups or by other groups committed to the achievement of human or personal potential. To realize this classification change from 1, 2, 3, to 4, 5, 6 are the fundamental requirement needed to understand our global society today.

II. The Impact of the Telecommunication Industry

It is the telecommunication that bridges between people, place and time. In the past, communication was made only face to face, and transportation was only used for moving goods and criminals or slaves. Now, any person, with the use of information technology, can communicate with anyone, anywhere and anytime. They don't need to move from place to place to communicate. Today, information technology can replace transportation for better communication. In order to create harmony and linkage, telecommunication is the essential tool.

Because of the rapid innovation of information technology, the borders that have been built over centuries are beginning to disappear. I like to think of telecommunications as a "block buster" of these borders, boundaries and barriers including those of:

1. Nations - with telephone, facsimiles, electronic mail and satellite broadcasting, people in one part of the world are able to communicate economically and timely. For

example, during the recent Gulf War, people all over the world could see the missiles flying on TV in real time. Moreover, the East European revolution would not have been known to the outside world without the use of telecommunications and the recent coup in the Soviet Union might have succeeded if telecommunications technology did not exist.
2. Industries - boundaries have dissolved and it is difficult to distinguish the boundaries of one industry from another based on the "merging" of different industries through advancements in information technology. For example, telecommunication and broadcasting boundaries have disappeared to create teleommunication-broadcasting, banking and securities businesses are difficult to distinguish. Through information technology, new services have been made possible, for example, in the transportation industry a worldwide quick delivery service become daily necessities.
3. Companies - industry barriers have broken down to enable companies to diversify their businesses, like in the case of a Japanese steel maker with its move to the production of computers and semiconductors, a textile company moving into the area of optical fiber cables, an agricultural equipment manufacturer becoming a computer maker, and a chemical company becoming a floppy disk and software maker.

We can see the heavy impact that information technology has made on business in general as well. Businesses can't survive, cannot provide solutions without information technology. No longer can businesses just provide products, they must provide solutions for the growing consumer demand for solutions to their needs and problems. For example, delivery companies rely on computerized data for scheduling, locations, etc. Banking and securities companies need computerized data for timely information to make accurate decisions. Point of Sales information is used by merchandisers to make planning and marketing decisions. And airline and other ticket entertainment businesses could not survive without computer data processing and transmission technology at their staff's fingertips.

These trends in breaking down the barriers will increase more and more through the improvement of information technology and with the deregulation of the industry. Without the national borders, industrial boundaries and business barriers, governments will no longer be able to define industries.

III. The Japan Experience

As you all know, Japan is one of the leaders in developing the information industry and is an essential part of the triad strategy of the development of many global communications businesses. The development of the industry has resulted in a very competitive marketplace and it is the Japanese experience which could provide direction and solutions for other nations who are not using the full benefits of information technology and who still maintain government-controlled monopolies in the telecommunications industry.

The two major reasons for this rapid development in Japan are deregulation and privatization. In 1982, the Second Adhoc Commission on Administrative Reform recommended that Nippon Telephone and Telegraph (NTT), be privatized and required to compete with Specialized Common Carriers. The main objective of this recommendation was to create a more effective communications infrastructure rather than to break up a monopoly. As a result the deregulation, competition in the telecommunication marketplace was introduced and partial restructuring occurred. The Telecommunication Business Law and the NTT Corporation Law went into effect on April 1, 1985, breaking up NTT -- with two requirements: one, that the Telecommunication Business law be reviewed within three years and two, that the NTT Corporation Law be reviewed within five years.

With this restructuring, telecommunication service providers were divided into two categories:
1. Type I - Telecommunication carriers possessing their own circuit facilities, and
2. Type II - Telecommunications carriers that lease the circuit facilities of Type I carriers.

With the deregulation that accompanied the privatization of NTT, a variety of different New Common Carriers (NCCs) were born. Competitors began rushing into the market in 1985, and in 1987, partial service was provided by these New Common Carriers. Today, the number of NCCs in Type I totals 66. In addition to NTT (and KDD - Kokusai Denshin Denwa, the international carrier), the number of carriers in each type of service is as follows:

Long distance	- 3
Satellite	- 2
Regional	- 7
International	- 2
Mobile	-16
Paging	-36

The major players in this category are varied. They include electronic and telecommunications equipment manufacturers, information providers, sogo shosha, financial institutions, securities firms, insurance companies, steel manufacturers, automobile manufacturers, construction companies, retail companies, transportation companies, publishing companies and broadcasting companies. These companies are participating as equity investors (aiming at a profitable return on investment from a successful venture), end users and as equipment suppliers.

In particular, the most aggressive companies to enter the rapidly growing telecommunications market are the sogo shosha. We, Mitsubishi Corporation are actively involved in the industry for two reasons:

First, we foresee that "sleepless" global networks will soon function as the "headquarters" of a business. While decision-making will become more and more decentralized in a worldwide organization, it will be crucial for the information to be centralized through both a "hardware" network - satellites, cabling, computers, and peripherals -- and a "software" network - information, ideas and people -- that have developed in organizations.

Secondly, in the present world, supply capability exceeds demand in almost every industry. Mitsubishi Corporation is handling some 30,000 products and services directly to its 30,000 corporate customers every year on a global basis. But, probably 90% of the products and services (supply capability) exceeds demand. Under these circumstances, we have to change from a product business to a solution business, which means that instead of selling products, we must sell solutions and we are constantly striving to be an excellent provider of the most

appropriate solutions for our customers. As a solution provider, Mitsubishi Corporation possesses two types of tools, or networks that are required:
1. infrastructure network: the basic information network on which the following network is based and operates:
2. info-structure network, including the people or human network - the creative/idea information network - the meaningful information network.

Because of these two reasons, Mitsubishi became a founder member of most of the NCCS, namely, DDI, Teleway Japan and Telecom Japan (domestic long distance carriers), TT Net and Osaka Mediaport (regional carriers), Space Communications Corporation (a satellite telecommunication company) and ITJ (an international carrier). As I was deeply involved in the founding of DDI, I am very pleased to say that among the NCCs, DDI was ranked No. 1 in 1990, with operating revenues of ¥155 billion and a net income of ¥11 billion.

Unexpectedly, most of the long distance, mobile and paging NCCs are enjoying good business results and are taking a relatively high share of NTT's market through their competitive strategies and more efficient operations. In some business areas, the NCCs have obtained over a 30% share of the market. This competition also generates more efficient and higher flow of information at cheaper prices -- resulting in remarkable growth of the Japanese economy and more competitive Japanese participation in the global telecommunication arena.

The Type II carriers, numbering 946 in early 1991, provide on-line data distribution and conversion, public database access, voice mail and leased circuit resale. Though this market in 1990 was estimated to be worth US $600 million, it remains unprofitable for all but a few operators. With this keen competition, there are still few leaders to choose from in the marketplace.

IV. Future Trends in the Telecommunication Industry

Since its beginning, the telecommunication service has been monopolized by one supplier. But now that the telecommunication has become a base infrastructure for every industry, the telecommnication serveices and products must move away from supplier-oriented to end-user or customer-oriented.

The technology of the telecommunication industry is changing rapidly, and in the coming decades we will see the speed of the development increase even more. Networking, open systems, downsizing (smaller and cheaper), and human interface/user-friendly products and services will be the rage.

Moreover, these changes will result in severe competition and more deregulation will be needed. The regulatory environment will indeed be challenged to cope with the changes I described earlier.

V. Conclusion

These trends are exciting for those of us in the telecommunications industry, but for the future development of the industry, it is essential that the information network must be global, more transparent and more efficient.
1. Global - it must be able to reach throughout the world, to tie people together so that they can communicate anytime, anyplace and with any person.
2. Transparent- so that all users can clearly understand the products and services available. This transparency is crucial and it requires a standardization of the protocol and systems that we have not yet seen in its entirety. Without standardization, interconnectivity and true communication is impossible.
3. Efficient - using the least amount of a person's most precious resource - time.

In order to reach these goals, I believe that separation of networks is not appropriate. Instead of separation integration of networks is crucial. For example, NTT, a domestic carrier should be allowed to conduct international communication business as well as KDD and vice versa.

Information technology is needed for the development of economies, to help create a better lifestyle for all peoples and to create global harmony and linkage. It is necessary for all of us to provide opportunities for the training of people around the world, and we must provide technological as well as financial support. This assistance will help other nations to develop their infrastructures and info-structures, resulting in a better lifestyle for our global society.

Today I have shared with you some of my thoughts on and experience in our revolutionary telecommunications industry. I look forward to discussing these in more detail with you during this conference.

Thank you.

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THE PRODUCTIVE CONTEXT IN SOUTH KOREA: A HISTORICAL ANALYSIS

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1. ABSTRACT

For the first time in the Republic of Korea's short history, the country's visual entertainment and information industries have the chance to become legally and economically stable. Their success depends upon crucial decisions currently being made by the government about future telecommunication infrastructure, ownership and system access. Government policies will determine whether the production industries are able to create an international demand for endogenous entertainment and information products as well as sustain a domestic market for them.

2. INTRODUCTION

In this paper we examine South Korean (Republic of Korea, ROK, Korea) telecommunication production opportunities (entertainment, news, information services) within the structural boundaries of 20th Century Korean society. We begin our analysis with a look at the historical evolution of film, telephone and television infrastructure and law. Discussion of the current direction of infrastructure and law then leads to an evaluation of production needs and capacity within the ROK. This assessment is tied to some closing remarks about South Korea as a potential cultural competitor in the international marketplace.

3. INFRASTRUCTURE HISTORY

3.1 FILM

Even though Korea was closed to foreigners and known as the "Hermit Kingdom" during the late 1800s, film came to the peninsula at about the same time it began appearing in Europe and North America. A French (Pathe) film may have been shown in Korea as early as 1898 and a short French film is known to have been screened in 1903. Seoul's earliest theaters exhibited American and French films even after the Japanese invasion of the peninsula following the Sino-Japanese war. This cultural freedom was short-lived, however, when Japan annexed Korea in 1910. Even though theaters spread rapidly around the peninsula, they were owned by Japanese and showed mostly Japanese films.

The first Korean film was made in 1919, the first feature film in 1923. The first motion picture company (Japanese) was established in 1924 and the first Korean company was founded in 1926. As many as 80 films per year by around 40 companies may have been produced in the late 1920s. Only about 10 films per year seem to have been Korean and that number dwindled throughout the occupation years to one or two. Korea's first sound features appeared in 1935.

Perhaps because some early Korean-made films were critical of the Japanese occupation (for example, *Arirang*), the occupational administration began censoring and otherwise restricting film production in the late 1920s. Many Korean filmmakers fled to Shanghai in the 1930s where they continued to make films, although these could not be viewed by the Korean public. The 10 remaining Korean film companies were closed by the 1940 Chosun Motion Picture Law and replaced by a single Japanese company (Chosun Film Company, Ltd.). Even stricter censorship and occupational circumstances led to production of mostly propagandistic films.

After World War Two, the peninsula was divided into North and South Korea with the latter under the temporary administration of the U.S. Military Government in South Korea (USMGSK). Despite the return of exiled filmmakers and the screening of previously-censored films, the revitalized South Korean film industry remained constrained by military restrictions. The USMGSK was anxious to defuse any leftist sympathizers in the southern peninsula and cracked down on leftist media of all kinds. It also asked the Chosun Film Construction Headquarters (born in 1945) to make newsreels.

The southern half of the peninsula became the Republic of Korea in 1948 with Rhee Syng-man as its first president. The use of film to further government purposes intensified during the Korean war in the early 1950s but film facilities and financial resources were wiped out. For several years after the cease-fire only a few 16mm films were made, most of which rehashed the war and its consequences.

Out of the circumstances of poverty and an agrarian economy a system of film financing called "iptosonmae" was born. Just as poor farmers began pre-selling

their crops in order to cover their expenses, film financiers set up a system to collect equal shares from promoters and theater owners in five regional blocks outside Seoul, a system that still exists. Promissory notes from these sources enable filmmakers to borrow enough money at high interest rates to cover the exact projected costs of producing a specific film.

Despite the adverse circumstances necessitating this unsatisfactory but imaginative financial scheme, film remained an important element of Korean culture. By the late 1950s theaters were rebuilt, the first colored films appeared and South Korea began to participate in international film festivals. Filmmakers gained a one-year respite from heavy government censorship between the forced resignation of Rhee Syng-man and a military coup by General Park Chung-hee (1961). Park's assumption of power brought severe curtailment of freedom of expression.

Under Park, film production soared (an all time record number of Korean films, 230, were made in 1969) but at the expense of source diversity. A series of Motion Picture Laws (MPLs) bankrupted many of the 71 production companies by requiring them to make at least 15 films per year, permitting those who met this quota to import foreign films. This arrangement led to the partial use of import profits for subsidization of domestic Korean production, a practice that persisted until 1985. Foreign import quotas also were instituted along with the mandate that theaters screen Korean-made films on at least one-third of viewing days.

Even though these policies ostensibly were designed to favor local production, they resulted in the demise of many small companies. Heavy government censorship and the requirement that filmmaking be a profitable enterprise additionally encouraged "quick and dirty," highly commercialized production. Over two hundred films were made in 1970 but most of them were of very low quality.

Only three film companies existed in 1973, a situation unremedied by the Fourth MPL which again demanded production of a specific number of films per year, further limited imports, reimposed foreign screening quotas, controlled the supply of film and once more restructured the industry. Under this legal revision import and foreign screening restrictions were accompanied by some seemingly positive encouragements to indigenous film production. Companies that made "high quality" films were permitted to import more foreign films, a reward rife with possibilities for corruption because of the subjectivity involved in deciding what constitutes high quality.

The Park government also replaced the old industry association with the Motion Picture Promotion Corporation. The MPPC's mission to encourage the existing industry provided further opportunity for favoritism toward particular companies and filmmakers. Implementation of the Fourth MPL occurred just after passage of the infamous Yushin Constitution which gave Park martial law control of the country and raised doubts about the motivation behind any media regulations.

3.2 TELEPHONE

The basic law covering use of the electromagnetic spectrum was passed in 1961 (The Radio Waves Regulation Act). This law gave the Ministry of Communication (MOC) authority over all electronic transmission infrastructure. Because broadcasting construction was primarily financed by large, private companies and was less costly than the building of a universally-accessible public switched network (PSN), 25 times as many South Koreans had TV sets in 1979 (almost 6 million out of a population of around 42 million) as had telephones.

The Chun government reversed this pace of development. The ROK used foreign loans and customer deposits to finance construction of a PSN beginning in 1982 when the government-created Korea Telecommunications Authority became operational (KTA). At the same time the Data Communications Corporation of Korea (DACOM) was established "to accelerate the development of data communications and to rapidly build a modern information-oriented society" (KOIS, 1987). In 1983 the Basic Telecommunication and Public Telecommunications Business Acts became effective. The MOC continues to regulate all telecommunication infrastructure and delegates responsibility for public facilities to KTA, an arrangement that has increasingly important implications for endogenous entertainment and information production.

In 1990 KTA supplied about 37 telephones per 100 population. DACOM-NET served close to 5500 subscribers and DACOM provided leased-line service to over 80,000 parties.

3.3 TELEVISION

The American military government created the Korean Broadcasting System (KBS) from the previously Japanese-controlled radio network. The Korean military initiated an alternate service

in 1950; the U.S. military service added a station in 1954. The first ROK private station, a Christian service, also was born in 1954. Other private broadcasting companies--Munhwa (MBC), Dong-A (DBS) and Tongyang (TBC)--evolved from 1959 through the 1960s when most also began constructing television stations. South Korea's first TV station, established in 1956, was destroyed by fire in 1959. KBS, TBC and MBC set up TV stations from 1961 on.

The advent of television affected the film industry even more than politics and economic downturns. Government policies, low quality films and a population tired by twelve-hour working days aided the takeover process during the 1970s and early 1980s. TV ownership shot up from 880 thousand in 1970 to around 8.5 million in 1984. Conversely, the film audience decreased from some 173 million in 1969 to around 48 million in 1985; per-capita film attendance descended from a high of 5.7 in the 60s to 1.1 in 1986. Film exports decreased from 201 in 1971 to 6 in 1984.

Despite the enormous popularity of the medium, television infrastructure development did not fare well under Chun. In a general clamp-down on the media, the government restructured broadcast facilities. KBS absorbed all private broadcasting companies with the exception of CBS (the Christian Broadcasting System) and AFKN (the American Forces Korea Network) and the partial exception of MBC (70% of whose stocks were given to KBS, the rest to a private foundation). CBS was forbidden from carrying news, general programming and ads. The Newspaper and New Agency Registration, the Press Ethics Commission and the Broadcasting Laws were replaced with a single Basic Press Law which permitted tight government control over both print and electronic media. The Ministry of Culture and Information was given authority over content. This Ministry is now split into the Ministry of Culture and the Ministry of Information. The latter (MOI) now assumes responsibility for content regulation.

Chun's restructuring of the television industry not only affected freedom of expression within the country but it also relegated virtually all domestic television production to KBS and MBC. Thus, a financially viable independent video production industry was not feasible until Roh Tae-woo was elected president, the media laws were changed, and KBS and MBC began to be challenged by alternative methods of television distribution.

4. CURRENT INFRASTRUCTURE AND LAWS

Under Park's authoritarian rule the ROK transformed itself from a war-devastated infant nation to a newly-industrialized, internationally-competitive country. Under Chun, the ROK moved into high technology, especially communication technology, and began to compete with the more developed countries in their rush toward information economies.

Under Roh more liberal media laws and conditions have provided an ambiguous direction for further construction of communication infrastructure and possibilities for expanded cultural production. Although new electronic distribution outlets are proliferating and the administration is somewhat encouraging software production, the Roh government still tries to control content, only more covertly than the Park and Chun regimes.

4.1 FILM UNDER ROH

The Fifth MPL (effective 1985) ruled that film importing and production houses could still be owned in common but that their operations had to be strictly separated. Importing companies now are required only to register rather than to acquire licenses. Intensified U.S. trade pressure resulted in the Sixth MPL (effective 1987) which gave foreign distribution companies the right to operate directly in South Korea. Foreign production companies also can establish operations in the ROK. The only remaining law protecting Korean filmmakers and producers is that theaters must still show Korean films at least two-fifths of viewing days.

Over 200 (as opposed to the old 25) foreign films are now imported into the ROK annually. In 1980 about half the audience share was realized by foreign films as opposed to 67% in 1986 and 73% after passage of the Fifth and Sixth MPLs. Regulatory changes have led to a staggering increase in the number of imported films (264 in 1989, 91 from the U.S. and 89 from Hong Kong).

Loss of audience is not the only consequence of market liberalization. The Seoul presence of large foreign distributors like UIP (Universal International Pictures) threatens not only the operations of domestic distributors but also the old structure of Korean film financing. UIP rather than Korean distributors will reap the profits from foreign screenings, thus removing the possibility for import subsidization of domestic production.

4.2 TELEVISION UNDER ROH

The existing government television system suffers not so much from lack of profits as from continuing control of

content. For example, Article 21 of the 1987 Constitution guarantees that "all citizens shall enjoy freedom of speech and the press." But Article 21 also says that "the standards of news service and broadcast facilities and matters necessary to ensure the functions of newspapers shall be determined by law." Article 21 further stipulates that "neither speech nor the press shall violate the honor or rights of other persons nor undermine public morals or social ethics" (ROK, 1987, p. 5). Thus, rights are accompanied by loopholes that provide the government with excuses for interference it thinks necessary.

The 1987 Broadcast Act, enacted one month after the Constitution, separates broadcasting from print media and cable systems. The Broadcast Act, although viewed as liberalization, strengthens loopholes available for control over radio and TV (e.g., see Articles 3, 4 and 5). Content guidelines contained in the Act provide formidable obstacles to scriptwriters and producers who want to get their material aired.

4.3 THE ADVENT OF CABLE TELEVISION

Even though the ROK had only small, mostly retransmitting CATV (community antenna television) systems in 1987, the legislature passed a Cable Broadcasting Management Act. This law, similarly to the Constitution and Broadcast Act, prohibits cable carriage of programs "which impede national security and public order; which disturb international friendships; which support or discourage certain interests, belief systems of specific organizations; news, editorials and advertising programs [except those already on "must carry" government supported TV stations] and other programs prohibited by the presidential decree" (Article 17, trans. Yoon Sun-hee). Article 15 of the 1987 Presidential Decree of the Cable Broadcasting Management Act further details content restrictions.

The law does not clearly spell out exactly how these regulations will be enforced or how cable content will be monitored. Nor does the law provide for import quotas, domestic production screening quotas or other protective measures. Legally, cable appears wide open to foreign programming as long as none of the content restrictions are violated by such material.

The country now has an estimated 900 CATV operations that serve around 3 million subscribers and one experimental cable system (which carries original programming in addition to retransmitting over-the-air signals). Many of the CATV systems, especially in the south of the country, are being challenged by Japanese DBS transmissions. But CATV systems only provide clearer representations of existing broadcast signals; cable systems will bring new programming and information services, some of which will be interactive. Consequently, communication experts expect cable to serve about 40% of households by the year 2000.

5. CURRENT PRODUCTION

As the Korean people increased their education and skill levels, they became more self-confident and less acquiescent. They insisted upon greater political freedom as well as higher wages and better working conditions, a campaign that continues today.

Until recently, South Koreans have had little time and money to spend on leisure activities. Those circumstances are changing rapidly. By 1991 the nation's 43 million people had attained a per capita income of US$5500, a figure that is expected to double by the turn of the century. Per capita leisure spending is expected to reach close to $1900 by the year 2000, an important development for endogenous cultural producers.

The largest problems remaining for cultural producers are how to raise capital, how to distribute their products, and how to find profitable niches in the international entertainment/information marketplace. The capital problem is exacerbated by an antiquated financial system used by the government to route people's savings to favored industries. So far, cultural production, including computer software, has not been given high government priority, although that situation seems to be changing as the biggest companies (chaebol) become increasingly interested in this economic sector.

5.1 FILM PRODUCTION

Because it is very difficult to recover high expenses from the small domestic market, Korean films cost only an average of 300-400 million won (approximately $400-550 thousand dollars) each (Kim, 1989a). Huh (1989) notes that only about one-tenth of the Korean films produced annually make a reasonable profit. In contrast an American film may cost over $45 million but has the opportunity to recover expenses and profit from a huge domestic and an immense international market.

Various estimates posit the existence of between 20 and 50 commercial film companies (mostly a single filmmaker). Most film companies are not financially stable and remain essentially one-filmmaker outfits. About 150 film

directors were registered as of 1989, only 60 of whom were actually producing films. Most film directors cannot support themselves and their families from filmmaking activities.

The iptosonmae system of film financing no longer works well for several reasons. The current condition of the domestic industry makes film investment risky so that regional promoters are not so willing to put their cash on the line in advance of production, especially for lesser-known filmmakers. Banks have never extended loans without considerable collateral. The increase in demand for endogenous productions should encourage investment in the industry.

In addition, promissory notes usually are issued for only 3-5 month periods during which films are expected to be completed, a practice that encourages poor quality aside from the amount of production investment. The MPPC is helping to remedy these problems but the amount of money it has for this purpose is still far from adequate despite increasing government funding. In 1986 the revitalized MPPC established a "Selection Committee" to choose high quality films and offer their makers one of two forms of support: funds for advertising the selected films or for production of subsequent films.

The MPPC received a 1989 government grant of 2.5 billion won ($3.5 million) to subsidize film activities (4 billion in 1990 and 5 billion in 1991). The same year it also acquired 4 billion won ($5.5 million) from box office receipts under a plan whereby theater owners pay a percentage of ticket receipts to the Culture and Arts Promotion Fund which promotes cultural activities around the country.

Interest-free production loans also are financed by money collected when film companies register with the government. Producers deposit 50 million won with the government and then receive nine-tenths back to produce the film. The other one-tenth supports overall film production. The MPPC also helps screenwriters, makes screenplays available to filmmakers and trains filmmakers. It is spending about one billion won ($1.4 million) each year on expanded and upgraded production facilities and equipment. In 1989 MPPC President Kim Dong-ho described plans for a new state-of-the art Hollywood-style production center to be completed in the next few years (1989, p. 46).

Production houses are encouraged to make higher quality films by increased support from the MPPC as well as the legal need to no longer depend upon import profits. Consequently, the ROK made 111 feature films in 1989 and exported 23. A number of these films were rewarded for their quality. Since 1987 Korean films, actors and actresses have won prizes at the Swiss Locarno Film Festival, the Moscow International Film Festival, the Venice International Film Festival and the Montreal Film Festival among others. The ROK also has set up a number of film awards: for example, the prestigious "Grand Bell Prize," the *Hanguk Ilbo* best film award and the Korean Association of Film Critics prizes. Undoubtedly, scriptwriters and directors have been helped also by the replacement of government film screening with industry self-regulation. One less positive side effect of this change is the increased production of soft porn films.

5.2 VIDEO AND INFORMATION PRODUCTION

At the end of 1990 South Korea had less than a dozen viable video production houses (capable of producing broadcast-quality TV). In expectation of a newly lucrative domestic software market, larger and more financially stable production companies are springing up.

Seoul Telecom, set up by the Dong Ah group in July 1988, is a prominent model for future production companies. It already contracts with ESPN and CNN and produces for MBC. Its goals are to be the top Korean as well as an internationally competitive production house. It is preparing to produce news programming with the expectation that the existing cable and broadcasting laws will be changed enough to permit multiple organizations to produce and distribute electronic news material within South Korea. Unlike most of the small broadcasting producers and commercial film companies, Seoul Telecom can afford to lose money until permanent cable networks and the new private television station are well under way (Chung, 1990).

Domestic software capabilities eventually will have to expand beyond film and video production. The country hopes to introduce wideband ISDN around the turn of the century; installation of a two-way cable system can be seen as an early stage in construction of a very broadband electronic highway into all South Korean homes and businesses (see Robinson, 1990). Domestically-originated value added services will require appropriate computer software.

6. DISTRIBUTION INFRASTRUCTURE

South Koreans now have about 1.2 TV sets per household, 80% of them color. 30% of those homes also have VCRs (about 3 million units). By 1995 VCR sales are

expected to hit 500 billion won (about $715 million). Reportedly, over 6 million of the 7 million prerecorded videos in South Korea are foreign made. The film industry has been slow in linking up with advanced technology industries.

The Korean government recently strengthened film and video production indirectly by creating more screening opportunities for domestic products. An experimental cable television system was launched in July 1991 and a new, private broadcasting station was expected to begin operation by the end of 1991.

6.1 CABLE (CATV) TELEVISION

The Electronics and Telecommunications Research Institute (ETRI) expects the cable TV industry to generate in excess of US$4 billion by the mid-1990s, almost $1 billion of which will come from the software market.

Responsibility for the experimental cable television system installed this year in two Seoul areas (8400 homes in Mokdong and Sanggyedong) has been assigned to three entities: infrastructure construction to the Korea Telecom (privatized and renamed KTA), system management to the Ministry of Communication (MOC), and programming (software) to the Ministry of Information (MOI). The system offers 7 channels during day hours when broadcasting stations do not operate (10 a.m. to 5 p.m.) Four channels retransmit existing over-the-air signals and 3 carry auxiliary programming and regional information. Two-way services include home security and fire protection. The government plans to construct 25 cable systems in 50 cities by 1993. Eventually each district's cable system will have 20-30 channels.

Critics have viewed the government's introduction of cable TV as a way to avoid deregulating government controlled broadcast TV. They also object to government control over cable. Currently, the MOC supervises transmission facilities and authorizes Korea Telecom (renamed because of privatization even though the government still owns the stocks) to construct all telecommunication infrastructure. The MOI licenses CATV managers and program producers and recommends people for Presidential appointments to the CATV Broadcasting Commission (charged with supervision of decency standards and cable administration). Dissenters have suggested alternative arrangements such as municipal or Commission licensing, free market supply of programming and an integrated legal structure achieved by combining the now separate cable, broadcasting and radio waves acts.

Another cable policy issue has been whether chaebol (Korea's very large conglomerates) should be involved in cable management. The government has decided to permit chaebol involvement; Korea's largest companies are preparing to participation in all aspects of cable hardware and software provision.

The government also is considering the case of press involvement. Press companies want to enter both the management and programming aspects of cable TV. The 1987 Cable Broadcasting Management Act forbids newscasts on CATV (the term used in the act) except those carried on KBS and MBC, whose channels cable companies must carry. The same reasoning applies to cable advertising under the 1987 law. This law obviously is outdated as it applies only to the old concept of CATV (community antenna television) as a retransmission system and misapplies to cable television as a program origination source (see Robinson, 1990).

6.2 PRIVATE BROADCAST TELEVISION

Introduction of the new private television station in Seoul, expected to offer one channel by the end of 1991, has been even more controversial than planning for cable television. Many media experts and broadcasting personnel regarded installation of this new station as a political move by the government to better ensure a favorable outcome in the ensuing presidential election. For several years before creation of the new station, KBS and MBC had been airing programs sympathetic to the complaints of workers and poor people, a practice critics say led the government to conclude that the two networks were being dominated by leftist, anti-ruling party interests.

According to these critics (predominantly university professors, KTA/MBC workers and the opposition party), the government created the new station in order to diffuse the effect of such programming on public opinion by splitting the viewing audience. The government maintains that it is trying to loosen up the media situation, encourage more diversity, move to a more privatized situation, and provide greater opportunity for broadcast advertisers. It also insists that it merely implemented recommendations contained in an electronic media study conducted by Korean media experts, the same people who later objected to the government's compliance with their suggestions.

Unfortunately, the juxtaposition of the act that created the new station with two other broadcasting system revisions passed by Parliament at the same time lends credence to critics'

arguments. The appointment of the KBS President was put under the executive branch and the Korean Broadcasting Commission had its policymaking function removed and the status and number of its commissioners reduced. These revisions were passed after members of the opposition party walked out of initial hearings.

The government also was accused of manipulating stock ownership so that it could retain control of the new broadcasting system which will be called the Seoul Broadcasting Company (SBC). The selection of Tae Young as the largest stock holder was fraught with intimations of corruption. For example, the company's stock prices jumped 72 percent just before its selection, its president has been closely connected with the ruling party, and the company has acquired various public construction contracts in the past. The president of the new private company, Yoon Sae-young, did not help matters when he declared that the station would target a middle class audience and reflect a conservative ideology.

Despite this controversy, the station should benefit the endogenous production industry. Unlike KBS and MBC (which produce more than 98 percent of their own programming), SBC has announced that it will rely completely on external production.

The government also is thinking of permitting some local broadcasting stations around the country and plans to launch a direct broadcasting satellite of its own in 1995. In addition it could lease an Asiasat transponder for both domestic and foreign future distribution of locally-produced programs.

6.3 OTHER INFORMATION INFRASTRUCTURE

Just as it pressured the ROK to open its film market, the U.S. has insisted that South Korea open its electronic information services market. The Telecommunications Business Act 1989 revision was designed to encourage telecommunications competition but did not specify exactly what kind of competition or how it could be introduced in specific information markets, problems that are now being worked out.

Questions remain about interconnections among private networks, access to international networks, and utilization of packet-switched networks. Restrictions in these areas kept the number of 1990 operating VAN providers to about 20, only 8 of which could provide data services to the general public. DACOM had been enjoying an unrestricted competitive edge. When competition was introduced, the company began offering cheaper, easier access and faster services with better back-up systems. The company also began to demand the right to own lines rather than being forced to lease them (at half price for long-distance) from the telephone company. Both companies moved toward utilization of packet networks for data transmission services.

The ROK debate is repeated in many other countries where interconnected private networks are favored not only by entities who build them but also by computer software companies who write operation and interconnection programs for them. Telephone companies, on the other hand, want to offer value added services universally on a centralized, monopolistic basis whereby both hardware and software can be easily standardized and all messages digitized and treated in essentially the same manner.

Strong private networks would encourage computer software production in the ROK but would decrease the infrastructure advantage offered by Korea Telecom control over telecommunication infrastructure. If multiple systems are constructed, a universally-accessible and economically-efficient integrated broadband network will be much harder to achieve, the situation now applicable in the U.S.

7. THE FUTURE

The Korean practice of using media income to support cultural production provides a potential means of ensuring the country's production future. Although the cultural support money raised from theater ticket sales is threatened by new film distribution laws, the Korean Broadcast Advertising Company (KOBACO) cultural fund can be increased by new opportunities for electronic advertising.

KOBACO now sells all television and radio advertising time on the two government controlled networks, KBS and MBC. It gives most of the revenue to the broadcasting companies but keeps a percentage for its own operating expenses, journalistic training, and development of the culture and advertising industries. Part or all of a similar electronic advertising fund and/or subscriber surcharge could be used to subsidize endogenous software production. Precedents set by existing and past practices make this a culturally and politically acceptable possibility.

Even if the endogenous production industry is strengthened by government (the government has been working on a 10-year culture development plan) and/or private subsidies, the fledgling

software industry will have to become export-oriented in order to make enough profit to guarantee its future financial stability. Kim Dong-ho, President of MPPC, commented in 1989 that Korean

> motion picture promotion policy in recent years . . . has been directed primarily toward cultivating the competitiveness of Korean cinema against foreign films, creating the environments conducive to the production of films with high artistic value, and acquiring the basis to explore the overseas markets for Korean films (1989, p. 45).

The MPPC and companies like Seoul Telecom already have established a national direction for internationally competitive production. The question remains as to exactly what kinds of Korean cultural products can be marketed internationally.

Huh (1989) suggests that American creativity and big production budgets successfully turn out highly entertaining films dependent on visual appeal and vivid representation of unusual occurrences. He believes that Korean filmmakers, because of their low budgets and lack of creative experience, should concentrate on making "serious films which address social problems or human experience" (p. 13). Korea's famous director Bae Chang-ho agrees with Huh's general goal for Korea's filmmakers:

> We Koreans today are in the throes of a heady and drastic process called modernization. Against the background of this kind of fast-changing society, so many people are presenting so many real-life comedies and tragedies almost daily. This, in other words, is a country so full of good stories for cinema. This is what makes the circumstances surrounding the motion picture industry in south [sic] Korea today so great (Bae, 1989, pp. 16-17).

Korea's cultural producers have always lived within unique circumstances. Their creative lives during most of the Twentieth Century have been shaped by political and economic events beyond their control yet they have managed to survive perhaps better than their more fortunate colleagues in many other countries. Now they are faced with a new era of relative personal freedom and a highly competitive and internationalized environment. Gilmore tells us that

> The talents and capabilities of [Korea's most accomplished] directors, as well as first-time filmmakers like Bae Yong-kyun, are indisputable. But they need the opportunities and the resources which will allow for aesthetic and cinematic decisions to be made outside of the context of the marketplace, and allow for the fulfillment of their inspirations (1989, p. 23).

Gilmore really argues for the needs of cultural producers the world over. He speaks to the contradictory circumstances under which artists and programmers work everywhere, the struggle between the liberty to make decisions outside the marketplace context and the economic freedom that comes with successful exploitation of that marketplace.

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GETTING TO GRIPS WITH THE PRIVATISATION OF TELECOMMUNICATIONS IN MALAYSIA

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1. ABSTRACT

This paper highlights the experiences of Telekom Malaysia as a privatised entity in a developing country. It concludes that while a mature market in terms of penetration is not mandatory for privatisation to be successful, a sound regulatory framework must be present to lend market certainty to potential investors. However, strong management is essential to make privatisation a commercial success.

2. Introduction

MALAYSIA has led the ASEAN region in moving its telecommunications entity from a Government monopoly to privatised enterprise. Rare in its boldness, it also marked the beginning of challenges, problems and solutions hitherto unknown to the Company.

The formulation of a national policy on privatisation has been central to the creation of Telekom Malaysia. First enumerated in 1983 as a policy aimed at emulating the spirit and track record of the private sector, privatisation has developed into a full-fledged policy accompanied with a well-defined Masterplan as well as an Action Plan.

Among the main objectives of the Government's privatisation policy was to reduce its presence in the economy. As important were the aims of increasing efficiency and productivity, reducing the Government's financial and administrative burden, and achieving equitability in the distribution of the nation's wealth.

3. Run-up To Privatisation

Preceeding Telekom Malaysia's privatisation was the process of "corporatisation", best described as a grooming process for privatisation. It is a process by which a Government department or agency is first placed on a private sector legal and commercial framework, but in which the Government remains the sole owner and shareholder, and management is in the hands of the Board of Directors.

Grooming has involved turning around the company and imbuing commericial practices so as to make the company better reflect its true worth. In the case of Telekom Malaysia, corporatisation commenced in 1987 with the issuing of a licence to the operating company and the creation of a regulatory unit within the Government, Jabatan Telekom Malaysia (JTM), both cloned from the previous government department (also named JTM).

The transfer of activities of a business nature from the Government entity to the new corporte entity involved numerous legislative changes resulting in the following:

- Telekom Malaysia assumed total management responsibility;
- Telekom Malaysia took over both the assets and liabilities of JTM;
- Telekom Malaysia took over all staff of JTM, who adopted the option of employment with the Company.

The highlight of the entire exercise was the end of the 4-year grooming period in November 1990, when Telekom Malaysia shares were listed on the Kuala Lumpur Stock Exchange (KLSE). The paid up capital was increased to 1.5 billion ordinary shares, and 470.5 million new ordinary shares were issued during this mammoth exercise. At the end of the day, Telekom Malaysia emerged as the largest public company to be ever listed on the KLSE, accounting for about 15 per cent of the total KLSE market capitalisation.

Today, the shares are still substantially held by the Government and approved isntitutions, while about 25 per cent is held by the general public, of which about one-third is held by foreigners.

4. Managing Inherited Problems And New Goals

Clearly, at the time of corporatisation, the Malaysian telecommunications market had not quite reached the maturity of that of developed nations. This posed peculiar challenges for the Company, as it had to prepare the financial basis for eventual listing while at the same time undertake substantial infrastructural development.

In response to the needs of the Company and the environment, various priorities were identified:

- First was to create an organisation which is both customer oriented and market driven.

- Secondly, a shift in corporate strategy was effected, emphasising marketing techniques for both traditional and new services rather than depending on natural market growth.

- Thirdly, quality of service was upgraded so as to encourage customer loyalty and greater use of services.

- Fourthly, sound financial management was implemented so as to be able to undertake network expansion, modernisation, computerisation, new services, and finance projects of socio-economic importance such as rural telecommunications, and yet achieving a good profit track record.

A decisive action plan was drawn up to meet the new, rather daunting challenges. These included:

- **Strengthening the organisation** through training of management staff in the business aspects of operations and investments, incorporating business planning, strategic thinking and proper management reporting. The organisation was also restructured in line with the rethink in corporate strategy, the main aim being to make the organisation more proactive and responsive to changing situations.

- **Increasing market penetration and take-up of services** through innovative sales ideas as well as fully utilising network capacity.

- **Introducing new services and businesses** so as to meet the varying needs of a burgeoning and discerning residential as well as business community.

- **Servicing the customer** through effective, automated billing, and prompt handling of customer complaints.

- **Optimising capital investments** by improving the mechanics of evaluating and approving capital investments. However, in instances where viability was not the primary criteria, efficient use of funds was emphasised.

- **Controlling operating expenditure** by reducing wastage and promoting the efficient and effective use of resources.

- **Improving inventory management** by strict supervision of new purchases as well as available stocks. A computerised inventory control system was defined and specified (and is presently operational), while a consultant was engaged for an overall appraisal of stores management.

- **Credit Control** by tightening procedures as well as improving billing and collection. As a result, the amount of trade debtors dropped to MR$362 million at end-1987 and has continued to drop thereafter.

- **Reducing interest payments and foreign exchange exposure** by prepaying foreign loans with cash surplusses made available through prudent operating and capital investment policies.

The various steps above were also necessitated by the fact that corporatisation meant that the Company no longer enjoyed the privileges and subsidies of a Government department. The increase in operating cost (eg vehicle licences and higher overtime) arising from the change of status was about MR$70 million in 1987, the first year of corporatisation.

5. Reaping The Benefits, 1987-90

As the first Government utility to be privatised, expectations ran high as to the revenue and market potential that the new company would unleash. However, the results of the first year of operations proved to be an eye-opener, and a case study of sorts for future privatised entities.

Against a meagre pretax profit of MR$4.9 million, expenses had jumped to a level almost equal to revenue. It was a case where with telephone growth of 8.5 per cent and mobile growth of 60 per cent, the telecommunications market was healthy but the Company was not.

It was concluded that the effective strategy that promised the kind of marked improvement needed to meet the 5 year flotation deadline, was aggressive growth in customers and sales, coupled with quality. The net effect of this strategy on the financial and business strength on the Company is outlined in the table below:

	1987	1988	1989	1990
Revenues (MR$mil)	1,644	1,882	2,141	2,574
Pre-tax Profits (MR$mil)	5	180	366	564
Return on total assets	0.1%	2.3%	4.8%	6.8%
Total telephones (mil)	1,131	1,247	1,388	1,585
Telephones/100 population	6.8	7.3	8.0	8.9
Mobile users*	17,400	27,300	39,400	54,600
Public payphones*	6,000	6,600	7,000	7,300

* does not include those of competing operators

As can be seen, both the financial performance and financial efficiency of the Company have shown admirable improvement, while the growth in profits of 115 times over 1987-90 has been acknowledged as exceptional. Market growth, which was initially affected by the economic slowdown in the mid-eighties, has been revitalised and set on the path of high growth. Registering 14.2 per cent growth last year, customer growth has been projected to grow at 15 per cent in 1991. As of June 1991, total telephones had reached 1.7 million (penetration of 9.2/100 population), and the number of mobile users reached 62,770.

6. Regulatory Issues

Regulation of the privatised telecommunications industry in Malaysia has been tailored along that of the UK, and is vested in the JTM. However, the forces unleashed by privatisation has made the need for an overall industry policy on both regulation and competition compelling. Fortunately, the matter is presently being addressed at the highest levels of decision-making in the country, and we hope for some resolutions soon.

What complicates regulation in the Malaysian case is that it has to do with an almost traumatic transition from a regulated monopoly to a multiplayer competitive playing field. Presently, the tendency appears to be to heavily regulate the existing national operator and at the same promote competition.

This has made regulation and regulatory decisions the most significant in terms of long-term impact on the Company. The Company handles this through consistent contribution at the various policy sessions held with the Government, while closely monitoring its impact at all times. The impact on some facets of the Company is stated below:

6.1 Services:

Telekom Malaysia operates under a licence to establish, maintain and work a telecommunications system providing domestic and international voice and other services to the public, for a 20-year (renewable) period. Under the licence. Telekom Malaysia must also

permit interconnection to its system from other operators, and levy uniform additional charges on these operators.

While the Company is assured of the business that was handled by the Government entity prior to corporatisation, this is nevertheless subject to part or parts of that business being transferred to others. At the same time, there is no assurance that in so far as new businesses are concerned, the Company will be allowed to enter them, despite being the first to request for authorisation.

The experience thus far seems to indicate that while the obligations expected of the Company (as enshrined in the licence) are explicit and expandable, the rights to its present business and access to new businesses are not guaranteed. Additionally, the scope of service has also been found to be open to amendment. It is for this reason that firm guidelines on regulation are crucial.

6.2 Price:

The pricing of basic services is currently provided for in both legislation and the licence, which states that rates for telecommunications services or for access to the network shall not increase by an annual percentage which exceeds the annual average increase in the consumer price index (CPI). There has been no change in the rates for rentals since 1983, nor for call charges since 1985, despite corporatisation.

Applications to establish or change rates are made to the Minister of Energy, Telecommunications and Posts, who gives final approval. This also applies to tariffs for new services, where there are no established criteria for charging.

In line with worldwide trends, the move towards cost-based pricing is in the pipeline, and the Company is getting ready by establishing an appropriate costing system. On the control side, it is not know what mode of price control the Government will adopt, but the Company is advocating the price cap based on a weighted basket of prices.

6.3 Quality of Service:

The development of quality standards has to a large extent been an internal company effort rather than one that is formalised. The licence, however, does require that a code of practice for consumer affairs be enforced; such a code has been drawn up and is made widely available through the telephone directory.

Internally, the Company has set its own targets for quality of service as well as for network quality. In terms of service, customer complaints is targetted to decrease from 0.7 complaints/DEL to 0.5 in 1995, while the restoration of telephone faults within 24 hours is targetted to improve from 94.3 per cent in 1991 to 96.5 per cent in 1995. Yet another criteria, operator response within 10 seconds (for all calls of all categories), is targetted to reach 100 per cent in 1995.

6.4 Social Obligations:

A unique and key feature of the regulatory framework drawn up in the Malaysian privatisation exercise is the mandatory nature of community service obligations. This is provided for not only in Telekom Malaysia's operating licence but also in the 1985 amendments to the Telecommunications Act 1950.

Specific provisions for promoting rural communications in Malaysia is a notable case in point. The Company has budgetted some MR$1.7 billion for the 1991-95 period for the provision of rural telecommunications, progress of which is monitored by a special committee on which the Government is represented. On average, Telekom Malaysia spends some 16 per cent of its capital expenditure on rural areas, which also account for some 13 per cent of subscribers.

The licence also provides for directory information and public emergency call services to be provided by Telekom Malaysia. Maritime emergency services and public call boxes are also social obligations the Company is expected to meet.

Telekom Malaysia has always been of the view that the burden of the rural obligation is a shared responsibility which other operators should also subsidise. It also felt that the universal service obligation should be made incumbent on all operators within the market segment that they are in.

6.5 Competition:

Competition in the local telecommunications industry presently exists in the areas of cellular mobile and public payphones. In the case of cellular mobile, Celcom competes with Telekom Malaysia's nationwide NMT 450 Mhz service with a predominantly urban E-TACS 900 Mhz service, while Uniphone provides payphone service in franchised urban areas. Telekom Malaysia is disallowed from competing in paging and radio trunking services, both highly competitive areas of business.

It is unclear what the official Government stand is on competition in the basic telephone service, but it is not expected to materialise in the near future. However, the Company is of the view that an official competition policy needs to be formulated, backed by a supporting institutional framework.

7. Points To Ponder

Not all privatisations are straightforward deals commencing with expressions of interest to buy a telco and its business, followed by hard negotiations and eventual sale of equity. To a large extent, the manner a country chooses to adopt depends on its needs and internal experiences. In this respect, we believe that the Malaysian experience raises some interesting questions for both developing as well as developed nations. For example:

7.1 What has privatisation facilitated that would have otherwise not been possible?

Freedom to chart the Company's course, mindful of national and consumer interests, but without being shackled and delayed by Government procedures comes foremost to mind. As an independent company, Telekom Malaysia has been free to manage its own finances, control human resources in a more strategic manner, reorganise the company to meet immediate corporate needs, chart career paths for its staff, as well as encourage a cross-disciplined approach to problem solving. Privatisation has also granted the Company the autonomy to make wider availability of service.

Human resources has been a particularly challenging area for the Company in the sudden transition from government to private. Nevertheless, the 60 per cent increase in telephone customers witnessed between 1987 and end-1990 has been achieved with the same number of employees, signifying a labour productivity improvement of 60 per cent over 4 years.

In the finance area, the Company has been able to innovatively prepay loans as well as arrange alternative financing schemes so as to reduce the debt burden. Proceeds from the flotation exercise in particular were chanelled to prepay loans.

7.2 Is a high penetration level necessary before privatisation?

We would argue that a high penetration is not a necessity, but that more importantly, the potential for a high rate of market growth must exist. In fact, it might even be said that a low penetration rate augurs better for the candidate to be privatised, in so far as it is a utility service provider.

It is our view that under natural market conditions, the penetration level will grow in tandem with economic conditions. A viable business, however, must be sustained through capable management.

Telekom Malaysia was fortunate that the above fundamentals were present and the Company was fairly healthy financially prior to corporatisation. Additionally, the nation's economic strength was also fairly strong.

7.3 What would be the sort of regulatory framework necessary for developing countries in a situation similar to Malaysia?

While theoretically regulation and privatisation can be said to be a contradiction in terms, it is our view that in any competitive situation, a referee must be present to police the various players, especially when there is a dependency relationship. Universal customer access brings with it the contentious subject of cost sharing, and the office of a regulator is essential for refereeing these issues. Licences merely serve to define the scope of business of each operator, but not the relationship between operators.

A developing nation, however, has unique characteristics that pose an additional challenge for the regulatory process. As has been stated, the community service obligation in respect of rural services is often contentious, especially when the privatised company must also prepare the financial basis for public listing.

Apart from balancing the profit motive and social obligations, a developing country may face the additional problem of having to manage high growth. For Telekom Malaysia, which is preparing for an annual customer growth of 15 per cent in the medium term, regulation should facilitate the achievement of high growth as well as social objectives.

Additionally, the object of the regulatory mechanism in a developing country must be specific. Clear guidelines in the area of service, price, quality of service, social obligations as well as competition is essential so as to inject certainty into the market.

7.4 Is the Malaysia privatisation experience ideal for the developing world?

Privatisation is by no means the panacea for the telecommunications problems of the developing world but it would be a good option to consider. This is especially so for countries seeking the benefits of independent funding, technology choice, service provision as well as organisational reform.

Much however depends on the political will to make the process a success, as well as the urgency seen for service improvement in the country. While the environment, such as the economic situation, helps ensure success, a country need not be at the height of economic success to reap the benefits of privatisation.

8. Future Prospects

Malaysia has a national vision and aspiration to be a fully developed nation by the year 2020. Spurring this Vision 2020 is the fact that the economy is presently one of the fastest growing in the world, having registered four years of consecutive growth with GNP averaging an annual growth of 13 per cent between 1987-90. Structurally too the economy has changed, with the main contributors to GDP being manufactured goods and petroleum rather than agriculture as in the years before.

Telecommunications has a key role in achieving this Vision, while satisfying the infrastructural needs of foreign investors flowing into the country. The Company's goal is to lift telecommunications in the country to a level comparable to that of developed countries by the year 2005. The number of telephone customers targetted for the year 2000 is 6 million, or one telephone for every 5 persons. All services will by then be provided through a modern and totally digitalised network.

On the agenda as a public listed company are possible listings on foreign bourses in the near future, which has tremendous implications for the Malaysian privatisation policy. It also makes credit control all the more crucial in meeting the expectations of investors as regards earnings and yield.

9. Conclusion

Telekom Malaysia has been fortunate that privatisation has worked well to achieve both national and corporate targets. The question for the future, however, appears to be how to achieve similar results in a multi-operator, competitive situation. Related questions would be how such competition should avert duplication of resources as well as sustain the core business.

There is today sufficient experience in privatisation around the world in privatisation to assist a country establish the rules of regulation and competition first, before adopting privatisation. We feel that an approach which views both privatisation and regulation as a single package is the most favourable, before the process itself is put into motion.

The industry regulator, the Director General of JTM concurs with this view. At a recent international seminar held in Kuala Lumpur, he has said: "I would...recommend to any country on the verge of privatisation to map out clearly the policies applicable in a privatised environment and the direction for the privatised company in order to avoid...differences in expectations."

DEVELOPING A SATELLITE COMMUNICATIONS POLICY FOR THE PHILIPPINES

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1.0 ABSTRACT

The Republic of the Philippines, with over 7,100 islands, is ideally suited to satellite communications technology. Domestic Satellite Philippines (DOMSAT) commenced service in 1979, but by the mid-1980's had fallen on hard times and has been unable to meet service demand. Therefore, beginning two years ago, the National Telecommunications Commission (NTC) began granting provisional authorities to new satellite carriers to enter the market. At this writing, four companies have been authorized, and others are pending. However, NTC's actions have been taken in a policy vacuum, with no overall guidance from government or vision of the future development of the satellite industry in the Philippines. It is mandated that the market will be competitive and private-sector driven, but the rest of the picture is unclear, and policy issues are arising that need government attention.

This paper describes the background to the policy making process being undertaken by the Department of Transportation and Communications (DOTC). The state of the telecommunications industry in the Philippines is reviewed, and ongoing efforts to strengthen the role of the private sector analyzed. The innovative nature of the process is also discussed, since it differs from the traditional way in which policy has been developed in the past.

2.0 BACKGROUND

2.1 Government Responsibilities

The Department of Transportation and Communications (DOTC) is charged with the development of overall policy in the telecommunications sector. Such policies should promote the orderly development of the nation's telecommunications sector in a way which benefits the Filipino people and the economic development of the country. The National Telecommunications Commission (NTC) is the regulatory arm of the Department, and uses both the policy statements of the Department and the franchises granted by Congress as guidance in regulating the industry.

2.2 Broad Policy Framework

In 1990, the DOTC issued the National Telecommunications Development Plan (NTDP), which set out the Department's overall policies for the sector and established a comprehensive set of service-oriented targets through the year 2010. As noted by the DOTC Secretary in the Foreward to the document, it "takes an aggressive privatization stance", and affirms the Government's intention to establish an environment to "enable the private sector to confidently pursue the expansion and improvement of basic infrastructure and services that are efficient and that respond to market needs."

The policy for development set out in the NTDP is as follows:

"The importance of an efficient telecommunications network as a foundation for economic recovery and growth is well recognized, as is the critical need to accelerate the development of telecommunications infrastructure and facilities in the Philippines. Therefore, the Government's primary goal for the telecommunications sector is growth to the maximum extent warranted by demand and by resource constraints, particularly foreign exchange availability.

The following fundamental policies will shape and drive this central principle of 'development first':

*a. **Private enterprise.** Private enterprise shall be the engine of sector growth, providing an efficient vehicle for development.*

b. Sector self-sufficiency. The sector shall be financially self-supporting with intra-sectoral cross subsidies fuelling development and expansion toward universal access goals.

c. Network interconnection. All public telecommunications networks shall be entitled to interconnection with each other and interconnection with private networks will be encouraged. Interconnection agreements shall provide equitable remunerative arrangements that compensate for facility usage and that recognize the necessity for intra-sectoral cross subsidies."

The DOTC will use these broad objectives in setting policy and providing guidance for specific sectoral developments. In particular, these policies will be guideposts for the formulation of the Government's satellite communications policies.

2.3 Need for Governmental Action

The impetus for the DOTC, as the Government of the Philippines' primary telecommunications policymaker, to formulate a formal domestic satellite communications policy comes from many directions.

Generally, satellite communications offers great promise for bolstering the Philippine domestic telecommunications network. With more than 7,000 islands, many of them forested and mountainous, the typography of the country would seem to be ideally suited for satellite communications. In addition, the existing terrestrial network has only limited reach in many parts of the country.

The Philippines also has a very low telephone penetration level of about one per 100 population and many villages and municipalities have no telephones at all. To remedy the latter situation, the Government created the Municipal Telephone Projects Office (MTPO), a separate unit of the DOTC, following the passage of the Municipal Telephone Act of 1989.

The MTPO's objective is to establish at least one public calling office (PCO) providing basic voice and data capabilities in each of 1200 municipalities in the country -- 80 percent of the total -- that are not yet interconnected to the public switched network. Early analysis by the MTPO identified several locations where it wanted to place PCOs or rural exchanges as likely to be more efficiently served by satellite rather than terrestrial link.

The Philippines has not been completely without domestic satellite communications. Since the late 1970s, Domestic Satellite Philippines (DOMSAT) had been providing interconnection for domestic interexchange service through a network of 11 earth stations. However, during the late 1980s, the company fell into severe financial and legal difficulties that prevented it from expanding service, despite customer requests.

Against the backdrop of DOMSAT's drawn out difficulties, the National Telecommunications Commission (NTC) began licensing new satellite carriers about two years ago. However, from a policy standpoint, the NTC's actions -- while attempting to answer the question of what would happen if DOMSAT failed -- raised even more policy questions that needed to be addressed. (See fuller description in 3.0).

Finally, the explosion of satellite television offerings on the AsiaSat 1 and Palapa B satellites, and the beginnings of a cable television industry in the Philippines raised a host of new questions. These developments refocussed attention on TVRO licensing issues and questions concerning the unauthorized reception of international satellite television transmissions that had been pending before the NTC for some time.

3.0 INDUSTRY DEVELOPMENTS

3.1 New Market Entrants

At the time the NTDP was prepared, only one additional satellite carrier had been granted a provisional authority by the National Telecommunications Commission to begin constructing a satellite earth station network. Additional carriers have since been granted provisional authorities. The NTC's actions can be summarized as follows:

Liberty Broadcasting Network Inc.

The first to receive a provisional authority to begin constructing a network was Liberty Broadcasting Network Inc., a business radio services carrier. Liberty was granted a provisional authority on October 27, 1989, to provide service through an initial network of 300 "micro earth stations" working with one or more hub stations operated by Liberty. Proposed services include point-to-multipoint domestic and international data transmission, digitalized sound messages, store and forward facsimile services, and dedicated lease channel services at speeds of 1200 and 2400 baud.

Liberty was granted a provisional authority for a term of 18 months for domestic services only. The NTC, on September 17, 1990, issued a new order approving a change of equipment supplier from Equatorial to Satellite Technology Management, of the United States.

Liberty has reportedly been in discussions with Philippine Long Distance Telephone Co. (PLDT) about working together to establish a network of very small aperture terminals (VSATs). PLDT also has an application before the NTC to provide VSAT services itself. No action has been taken on that application yet. PLDT is the largest telephone carrier in the country, providing service to 94 percent of the nation's telephones.

Clavecilla Radio Systems Corporation

Clavecilla was granted provisional authority on September 11, 1990, to provide domestic services through a network of VSATs operating through a central hub station. The initial network would be designed to carry data, video and simultaneous voice data (SVD) services. Clavecilla was given 12 months to install its network and the provisional authority was given a term of 12 months.

Clavecilla was a family-owned record carrier founded at the end of World War II, which had devastated the nation's telecommunications network. The company had become an insignificant player in the domestic and international record market by the late 1980s. To prosecute the creation of its VSAT service network it joined with Global Mackay Cable & Radio (GMCR), one of the largest Philippine international record carriers. Later, a bill was introduced into Congress to permit the formal merger of these two companies.

International Communications Corporation (ICC)

ICC was given provisional authority on December 20, 1990 to construct an initial network of 200 small or VSAT earth stations. Proposed services were full duplex (two-way), point-to-point and point-to multipoint data communications. ICC was given 360 days to construct the network and to begin commercial operations, though the provisional authority was given a term of 18 months.

More recently it was announced that Australia's OTC International, a subsidiary of the Overseas Telecommunications Commission (Australia), had purchased 40 percent of the company and would invest $20 million in a joint venture to create a data, voice and video satellite network.

Capitol Wireless Inc. (CapWire)

The more recent entity to obtain provisional authority was CapWire, an international record carrier, on March 27, 1991. It was authorized to construct an initial satellite earth station network of 20 earth stations, primarily in the central and southern portions of the country. Proposed services included "toll quality" voice telephone communications and data communications links to other carriers. A hub station would be located in the Metro Manila area to facilitate interconnection with the national network. The provisional authority covered only domestic communications services, though authority to also provide international services had been requested.

In fact, however, CapWire, in between the filing of its initial application and the issuance of the provisional authority, had studies conducted and was actively pursuing plans for a much larger backbone satellite network. In October 1991, CapWire signed a memorandum of agreement creating a joint venture with the DOTC to own and operate 56 earth stations. These earth stations will be tied into an additional 30 stations wholly owned and operated by CapWire. This network will be used to provide carriers carrier services to other telecommunications operators as well as MTPO public calling offices and rural exchanges.

3.2 Recent Developments

At this writing, all of the new entrants have begun installing their systems, and it is expected that they will be providing service early in 1992, through several hundred earth stations scattered throughout the nation.

The assets of DOMSAT, having been foreclosed by the government's Asset Privatization Trust, have been put out to public tender, and five parties have expressed an interest in bidding on the system, including the monopoly international satellite carrier, Philcomsat.

4.0 POLICY ISSUES

4.1 General

The Philippines is perhaps unique in Asia for having a long established, private sector based competitive telecommunications market. Others, starting with Japan and now several more, are also beginning to introduce privatization and competition into the telecommunications sector. In the area of satellite communications, however, the Philippines has had a monopoly situation. Therefore, many of the policy issues being raised now regarding domestic satellite communications are of the sort that may be faced by neighbors in the region who are breaking longstanding PTT monopolies by permitting one or more satellite carriers to emerge.

Within the Philippine context, recent developments, such as the DOTC-CapWire agreement, have added an urgency to the policy formation process. Even before that agreement was signed, however, the regulatory actions taken by the NTC highlighted the need for a comprehensive policy statement by the Department concerning satellite communications.

4.2 Market Structure

The NTC's actions implied, but did not clarify the concept that two classes of satellite carrier would exist -- those offering retail, "VSAT" services, and those offering carriers carrier services. It is unclear whether this segmentation of the market is an appropriate or even practical long term approach. Telecommunications links to Manila, the nation's primary communications and commercial hub, are in short supply for both large users, such as extractive industries, government enterprises and banks with nationwide operations, as well as for domestic and international record and voice carriers.

It is unclear whether the terrestrial carriers who might opt for satellite links to Manila or elsewhere in the country should be required to chose among only CapWire and DOMSAT, the two carriers carriers, or whether they

should be permitted to seek the best combination of technology, availability and price from any of the satellite carriers.

4.3 Market Entry

In the NTDP, the Government stated that it would "discourage fragmentation of the Philippines market for domestic satellite service". At the same time, the benefits of competition have been well documented and are generally promoted by the government. The NTC's actions have created the potential for vibrant and useful competition in this sector. But, with five carriers now licensed to provide satellite service, the question becomes, what is the optimum number of satellite carriers now and in the future?

The objective, obviously, is to maintain an efficient and effective level of competitive tension in the market. But, as a developing country with a shortage of human and material capital and hard currency, the question becomes if and when additional players should be licensed for participation in the market. Further, the question takes on an added dimension based on assumptions about the market structure. A segmented market with two carriers in one service category and three in another is obviously different from a market with five carriers free to choose their product and service offerings to meet market expectations.

4.4 Ownership and Entrance Restrictions

The interests of certain related sectors, such as terrestrial telecommunications carriers, especially the dominant carrier, PLDT, and broadcasters, raises the question of whether certain parties should be restricted in the manner in which they may participate in the satellite communications sector or have an ownership interest in satellite carriers. Some broadcasters have already subscribed to capacity directly from Palapa to meet their own needs for nationwide distribution of television network signals. Beyond this, however, the question emerges as to whether broadcasters leasing space segment capacity should be permitted to provide services to others.

The Philippine Communications Satellite Corporation (PhilCOMSAT), the country's INTELSAT Signatory, has already expressed an interest in taking over DOMSAT. It might also someday become a purveyor of INTELSAT space segment capacity to domestic satellite carriers. The expertise it could bring to domestic satellite communications must be balanced, however, against its market power as the monopoly provider of international satellite communications services.

Finally, satellite communications, like all telecommunications, requires large amounts of capital. Local sources of such capital are limited. Currently, foreign ownership of communications companies is limited to by the constitution to 40 percent. Should a more permissive attitude towards foreign investment be taken?

4.5 Satellite Television Issues

The NTC has had a rulemaking process underway for some time addressing the issue of the licensing of television receive-only (TVRO) earth stations and the unauthorized reception of video signals being carried on INTELSAT satellites. However, larger issues loom, because of the growth in Asia of satellite video services specifically designed to attract regional audiences. While AsiaSat, with its package of television programming, covers only the northern part of Luzon, other regional satellite services have signed on with Palapa, which covers the Philippines. Additional services may emerge on future satellites covering the region as well.

Therefore, the question is how these foreign entrants into the domestic broadcasting "mix" should be handled from a regulatory standpoint. Further, domestic suppliers of video programming may also emerge as cable systems and TVROs become more widespread. No policies or regulations for these services currently exist.

4.6 Space Segment Availability

The Philippines has always relied upon the Indonesia satellite system, Palapa, for space segment capacity, since besides INTELSAT, few alternatives exist. However, new space segment capacity is expected to come on line in the region in the next several years. On the other hand, demand for space segment capacity from the five domestic satellite carriers and the broadcasters permitted to obtain their own capacity directly could soon put a strain on available capacity. Competition in other countries could also lead to a spurt in demand for available satellite capacity in the region.
The question here is whether DOTC should play a role in attempting to match Philippine satellite demand with supply. Should a shortage develop, the government would undoubtedly be quickly brought into the situation. Longer term, the question emerges whether the Philippines should consider obtaining its own satellite system, perhaps one of the "lightsats" now being promoted in some quarters. However, since the carriers are privately owned and DOTC plays an investors role in only one earth station network, the question would be, under what legal and organizational framework would such a satellite be procured and operated?

4.7 Role of the Government

The latter question leads directly into a larger one about the role the government should play in satellite communications. The DOTC is designated as the primary telecommunications policymaking body of the Government and the NTC as the regulator. Nevertheless, adjuncts of the Department have also traditionally been involved in operational matters and the recent MOU with CapWire will give the Department an investment, at least, in the satellite sector as well. Efforts need to be made to insure that this dual role does not create conflicts. After all, while the department's reason for entering into the joint

venture with CapWire is to promote the use of satellite communications to meet the communications needs of the country, the CapWire network will not accomplish this alone and the other domestic satellite carriers have a vital role to play in a competitive market.

In addition, however, the government as a user of satellite services needs to examine how this role can be fulfilled in a way that promotes the vitality of the domestic satellite sector. Further, the lessons learned elsewhere as to how to use satellite communications to extend educational and social services to rural and underdeveloped areas need to be reviewed for their applicability to the Philippine situation. The government would obviously have to take the lead in these efforts.

In the policymaking exercise which has been initiated, other issues may emerge, but these latter six would appear to be the core questions.

5.0 POLICY OBJECTIVES

The issues noted above require government attention, and their resolution will involve the balancing of conflicting interests. In this process, the options considered will be measured against the prime government policy thrust, namely growth, through the private sector, on a self-supporting basis, given the demand and funding constraints. Moreover, growth is most urgently required in remote and rural areas, where satellite communications may be the most cost-effective means of establishing links to the existing network infrastructure. It is vital, therefore, to ensure that the market is not burdened with too many operators, which would threaten the viability of the existing players, who are essential to the provision, at reasonable rates, of satellite services for rural applications. It is, therefore, a question of drawing a line between a competitive marketplace, as mandated, and the need to expand into marginal market areas, with a minimum of government involvement. This balancing act is no mean feat, and possibly unique in the telecom world for a developing country.

6.0 POLICYMAKING PROCESS

6.1 Staff Research/Consultant's Report

The first activity undertaken by the DOTC was to request the satellite service providers identified in the previous section of this Paper to provide the necessary information on the following topics:

- Brief history of the service provider including its facilities and the market currently served;
- Services offered and plans for the improvement/expansion of satellite communications systems;
- Issues regarding government regulation, proliferation of service providers and problems which hinder the development of satellite-based services;
- Recommendations on the coverage and the methodology in formulating the policy.

This undertaking was primarily aimed at assessing the present satellite communications structure and current issues to serve as a guide for the service providers, regulators and users of this service and facilities with the end view of preparing a Background Paper.

This activity was later supplemented. To this end, resources provided under the CIDA Technical Assistance Program have been assigned to work with DOTC Planning Staff, and USAID has provided added consulting assistance (later to be referred to as the Group). This Group has evolved an action plan, and the process is underway toward a draft policy for further discussion. Carriers and other stakeholders were approached for preliminary discussions, and a background paper was prepared based upon these inputs and other research.

6.2 Request for Public Comment

As part of the process of formulating a policy statement, the Department is scheduled to release very soon a Request for Information and Views to international and domestic voice, data, telegraph and telex carriers, as well as the present satellite carriers. Views will also be sought from broadcasting industry, various trade and business associations, academia, interested government agencies and the general public.
The purpose of the Request is to solicit information and opinions concerning the issues raised to date and to identify any other matters which may have been overlooked in the internal DOTC review. It also intends to verify the information that were collected concerning the current state of development of the domestic satellite industry.

A public reference file was created and is being maintained by the Department to contain a copy of the Request, all background materials gathered, all non-confidential information filed in response to the Request along with all opinions on policy matters.

6.3 Planned Issuance of Draft Background Paper/Options Paper

The information and views provided from the activities described in the preceding section will be used to develop a comprehensive background paper summarizing the information and issues identified, opinions expressed, and propose some tentative policy guidelines for the orderly development of satellite communications in the Philippines. The Department's target is to release this Background Paper for public review and comment early in 1992. This Background Paper will also be issued for public review and comment.

6.4 Release of Department Circular

The responses received by the Department will be analyzed and reviewed by the Group and policy recommendations would be made to the Telecommunications Policy Programs Review Committee (TPPRC), a committee created by the DOTC Secretary to provide high level review of all the Department's policy planning and implementation activities to ensure that the government's overall goals for the telecommunications sector are being met. With the TPPRC approval, the Secretary would then be briefed and asked to endorse and issue the policy. This policy would then form the basis for guiding future regulatory and other related decisions by the Government. If legislation were to be required, this too would be developed during the policy development process. The Department's target is to officially release the Department Memorandum Circular in April 1992.

The above process represents a first for the Department. The development of a policy through a consultative process is not new, but in this instance, it is intended to consult with all stakeholders, and then issue the government's policy in final form after due consideration of all inputs. As this process is developed, it is intended to form the basis for a policy-making model for the other issues confronting the TPPRC.

7.0 FUTURE APPLICATIONS OF POLICY PROCEDURES

The process employed in this matter is new to the Philippines. In the past, a consensus approach has been followed, sometimes successfully, especially on broad policy formulation. However, in recent years, this approach has been found wanting, since conflicting interests in a competitive environment make common ground on some issues difficult to find. The result has often been a stalemate, or worse, a "lowest common denominator" sort of policy statement. Such statements have been of little use to the regulator, NTC, which faces precisely the issues that the consensus process could not resolve. In the end, the regulator had to act without policy guidance.

This process seems lengthy, and will open up more issues that some parties do not wish to see resolved by the government. Moreover, there may be pressure on the government to avoid making policy, from those who are served best by the status quo. This will be a necessary part of the process, and must be managed by the policy body. The issue of confidentiality is also new to this process, and it is not clear whether the parties "trust" the process enough to reveal to the department sensitive marketing information.

The above problems notwithstanding, it is believed that this approach could be successfully applied to a number of national telecommunications issues currently under study. They include:

- cellular radio policy;
- ratemaking issues (unbundling, customer provided terminals, resale etc.)

The objective of the process, when one considers the scarcity of skilled staff, and the workload on government officials, is to harness the energies of the private sector parties who have a stake in the process. They will be encouraged to the raw material on which informed policy choices can then be made. Time will tell.

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Lessons drawn from 2 existing regional satellite networks : ARABSAT and EUTELSAT. Application to the Pacific Basin projects

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1. ABSTRACT

Two regional satellite networks have been in operation for more than 6 years «ARABSAT and EUTELSAT». After a brief description of each system, the current use of their payload is reviewed and compared with their respective planning stage predictions. From this perspective, some teachings are drawn which could be profitable for emerging regional Pacific Basin networks, now in the planning stage.

2. DESCRIPTION OF TWO EXISTING SATELLITE NETWORKS

2.1. ARABSAT

This network belongs to the ARABSAT organisation which includes more than 20 countries of the Arab League.

A contract was signed with AEROSPATIALE as prime contractor in 1981 for the construction of 3 spacecraft. The first two were launched in 1985 i.e. ARABSAT 1A with ARIANE in February 85, ARABSAT 1B with the U.S. Shuttle in June 1985.
The third model, ARABSAT 1C will be launched in early 92 with ARIANE.

The payload consists in 25 channels at C-band (33 MHz bandwidth each) plus an S-band channel. The nominal coverage as shown in figure 1 is a shaped beam at C-band and an elliptical area at S-band.

The edge of coverage EIRP at C-band is 31 dBW (center : 34 dBW) and 41 dBW at S-band (center 45 dBW). 1A is located at 19° East longitude, 1B at 26° East (see coverage at figure 2).

The main ground control station is located near Ryadh in Saudi Arabia while a back-up station is situated near Tunis in Tunisia.

2.2. EUTELSAT

The EUTELSAT organization is based on the INTELSAT model, its membership being limited to European PTT's. Presently 29 countries are involved. Its space capacity includes two generations of satellites.

The first one, EUTELSAT I, is composed of 4 spacecraft, launched between 1983 and 1988. Each satellite includes up to 12 Ku-band channels covering Europe in 3 spot beams and 2 wider beams (fig.3) with an EIRP of 39 dBW at the edge (45 dBW at center). Presently, 3 models are still active.

The second generation, EUTELSAT II, is composed of at least 6 satellites contracted with AEROSPATIALE as prime contractor. The first one was launched in August 1990 while the second was launched in January 1991.
By mid-1992, 4 such models will be on orbit.

The payload consists of 16 Ku-band channels with higher EIRP.
The coverage (figure 4A and 4B) can be switched between a large European area, with an edge EIRP of 44 dBW and a narrow central Europe beam, with an edge EIRP of 50 dBW (center 52 dBW). This flexibility is available by ground command to any channel. The satellites are controlled from the headquarters of the organization located in Paris, France.

3. CURRENT USE OF THESE NETWORKS

3.1. ARABSAT USAGE

As of November 1991, ARABSAT 1A was used by several Arab countries while ARABSAT 1B is partly leased to India which occupies four half-transponder channels for India Television. On ARABSAT 1A, 5 channels are occupied by full-time national television programs of Saudi Arabia (2), Oman, Morocco and Mauritania while 2 more are used for occasional-use TV service.

Concerning regional Telephony (FDM/FM or SCPC traffic), present loading is about 35 % of the capacity set aside for this purpose. Domestic telephony loading is also fairly low as compared to capacity.

Finally, the S-band channel has been switched on in November 1990, it carries the Egyptian domestic TV program.

3.2. EUTELSAT CAPACITY USAGE

Here is the current transponder loading status (see fig.5) in number of transponders.

EUTELSAT I at 7° East (F4)
8 TV channels with radio programs on sub-carriers .
1 business communication (SMS)
2 occasionnal TV
1/2 EUTELTRACS

EUTELSAT II at 10° East (F2)
5 TV channels + occasional TV
4 business communications (SMS)
1 closed user group (French racing channel)
1 domestic telephony (Denmark)

EUTELSAT II at 13° East (F1)
8 TV channels + radios (13 programs)

EUTELSAT I at 16° East (F1)
(on inclined orbit)
1 EUTELTRACS

EUTELSAT I at 21.5° East (F5)
2 Regional TV (EBU)
6 TDMA telephony
3 occasional TV

4. COMPARISON WITH DESIGNER PROJECTIONS

In the case of EUTELSAT, the design of the first generation satellites occured in the late seventies. At that time, television in Europe was still ruled by state monopolies and the bulk of satellite occupancy was predicted to be regional digital telephony and broad band-business services (all channels were 72 MHz wide).

However these projections did not materialized (see figure 6), the business services had a slow start, partly due to the high fees asked for wideband teleconferencing and high bit rate data transmission.
On the other hand most western European countries gave up their television monopolies during the 80"s and scores of commercial television companies sprung up, eager to reach the wide audience accessible via satellite transmission. This trend was taken into account for the design of the second generation satellites (EUTELSAT II) where 9 out of the 16 channels are 36 MHz wide and where the coverage can be zoomed on a narrow, high EIRP, beam (called «superbeam») enabling individual reception of TV channels using 80 cm. dish .
Recently, a new commercial service, not envisaged at the design stage of the EUTELSAT satellites has been launched, dubbed EUTELTRACS, it consists of a land mobile service providing two-way message exchange and position reporting for vehicles anywhere within the satellite coverage (the signals from the mobile to the base station are up-linked in a dedicated 36 MHz bandwidth, the base to mobile link takes up another 2 MHz bandwidth).Two satellites are involved for positionning (see figure 5).

South of Europe, in the Arab states, the national television monopolies did not break up, moreover law-makers, there, are not inclined to let western style programming reach the general public. Therefore ARABSAT did not undergo the tremendous TV capacity demand increase observed with EUTELSAT. Thus, although, the original motivation for ARABSAT came from the national broadcasters of the Arab States Broadcasting Union (ASBU), the backbone use of the system became telecommunications.

The fairly low filling ratio of ARABSAT transponders has several causes among which :

- the communication ground antenna in the various member countries were put into service very slowly and generally several years after theoritical start of the system,

- the rates are comparable to, rather than, competitive with INTELSAT,

- contrary to expectation there is not a high degree of inter-Arab traffic, most of the international traffic appears to be going over INTELSAT to other countries.

In summary in both cases, about ten years after design, the distribution of services is not what was projected, the obvious conclusions is to achieve flexibility in satellite payload to cope with market evolution.

5. SITUATION IN THE PACIFIC BASIN

In the Pacific Basin several private and governmental regional satellite networks either newly existing or in the design phase are vying to deliver services to potential customers. Theses services include national Television, commercial Television, VSAT networks, and regional or domestic telephony.

The countries involved in most coverages of these systems are not as much related as say European Countries on one side, the Arab States on the other.

For example the legislation for television provision is very different in Burma/China and Thailand/Taiwan - all countries included in the coverage area of ASIASAT 1.
Still, Television is considered as the most promising money making service, while point to point telephony has to keep into account the competition of optical fibers throughout the area. Otherwise VSAT networks will only interest fairly developed nations and many of these networks are needed to fill up a transponder while only one is necessary with Television (a 36 MHz wide transponder is assumed).

Although happening in another part of the world, the experience gained with the two regional systems described previously, ARABSAT and EUTELSAT, should be used to lay down some general principles.

Therefore the following considerations should be kept in mind for those in charge of designing the payload of future similar satellite systems or trying to assess potential markets :

- keep flexibility in the payload (transparent transponder, steerable beam),

- Television is likely to be the backbone service for capacity loading and revenue making,

- countries with liberal TV provision policies should be marketed heavily,

- set the transponder lease rate at a competitive level with respect to INTELSAT,

- catch the market of world wide TV network (e.g. CNN),

- do not expect telephony either trunk routes or thin routes to take up much loading (Major routes are already installed with optical fibers and thin route is hardly a contender to fill up capacity),

- Also, communication ground station availability has proved to take time and alter many a business plan.

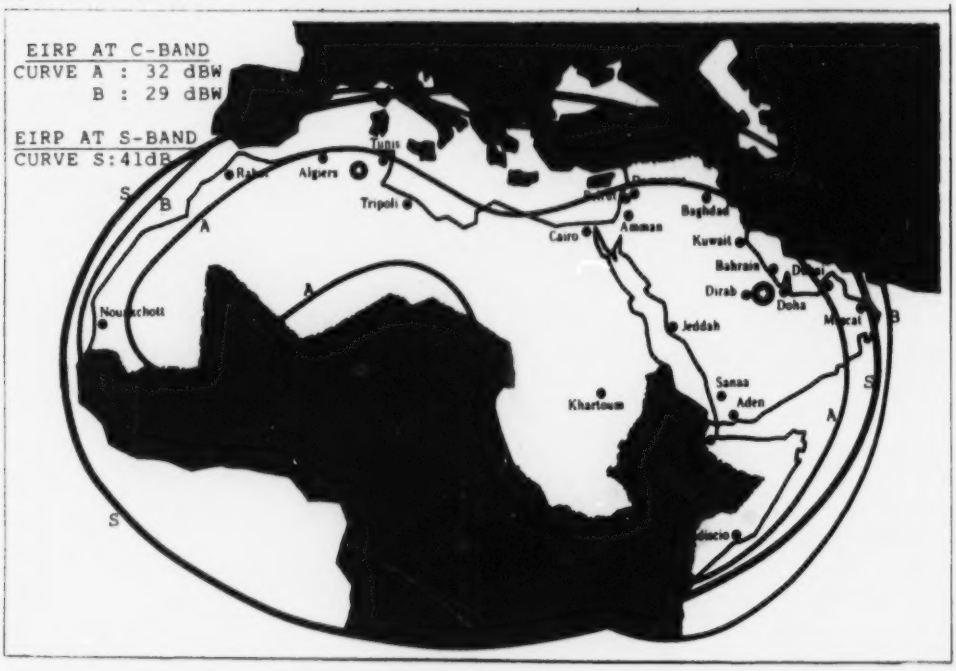
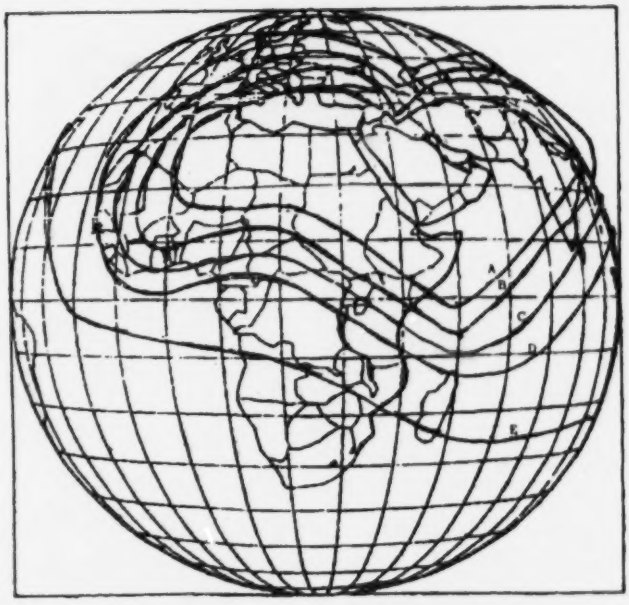


FIGURE 1 - ARABSAT 1A (19° EAST) TRANSMIT COVERAGE



EIRP AT C-BAND:
CURVE A : 32dBW
B : 30dBW
C : 28dBW
D : 24dBW
E : 14dBW

FIGURE 2 - ARABSAT 1B (26° EAST) C-BAND TRANSMIT COVERAGE

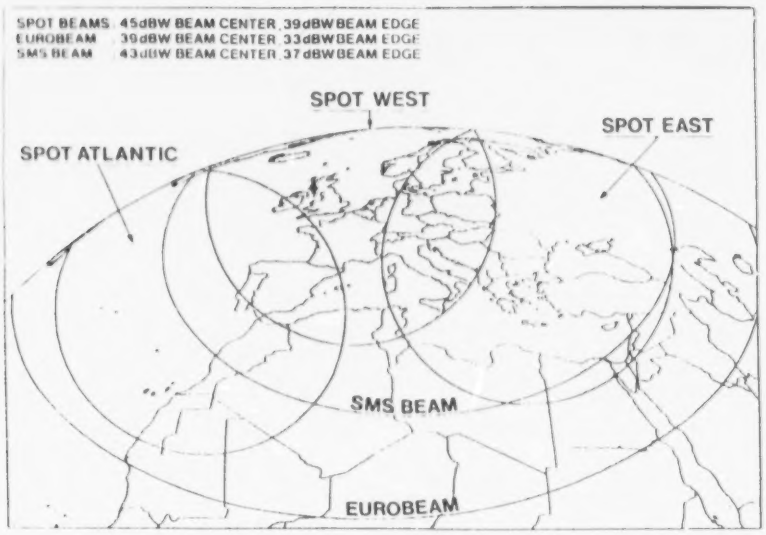

SPOT BEAMS 45dBW BEAM CENTER 39dBW BEAM EDGE
EUROBEAM 39dBW BEAM CENTER 33dBW BEAM EDGE
SMS BEAM 43dBW BEAM CENTER 37dBW BEAM EDGE
SPOT WEST
SPOT EAST
SPOT ATLANTIC
SMS BEAM
EUROBEAM

FIGURE 3 - EUTELSAT FIRST GENERATION TRANSMIT COVERAGE

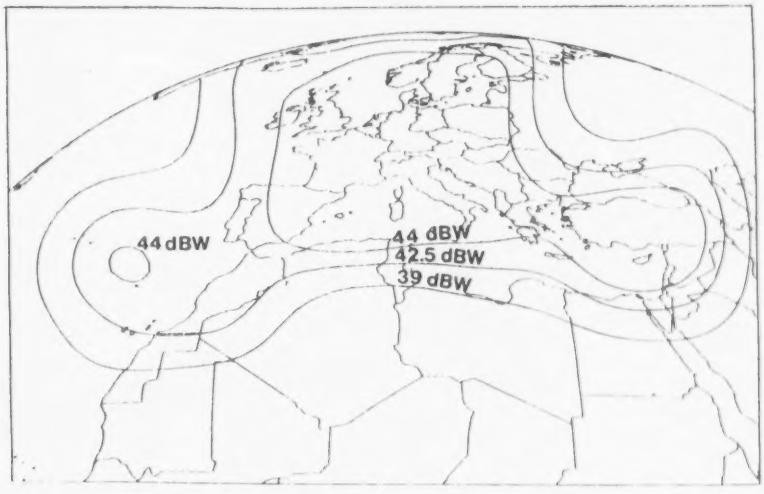


FIGURE 4A - EUTELSAT 2ND. GENERATION TRANSMIT COVERAGE - WIDE BEAM

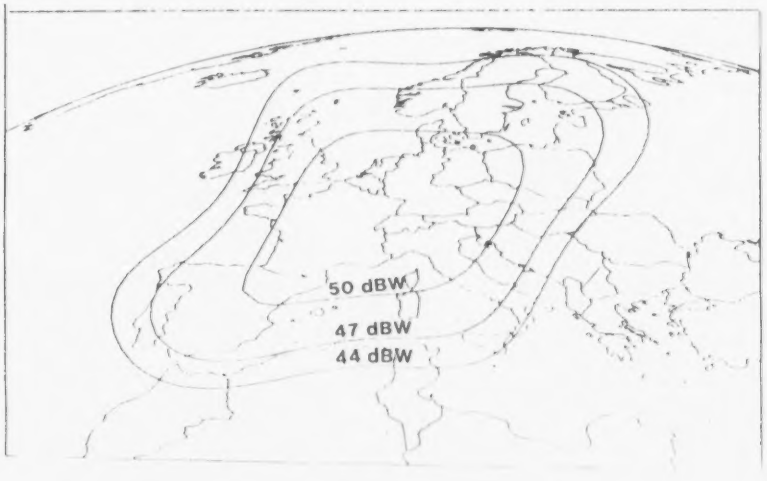


FIGURE 4B - EUTELSAT 2ND. GENERATION TRANSMIT COVERAGE - NARROW BEAM

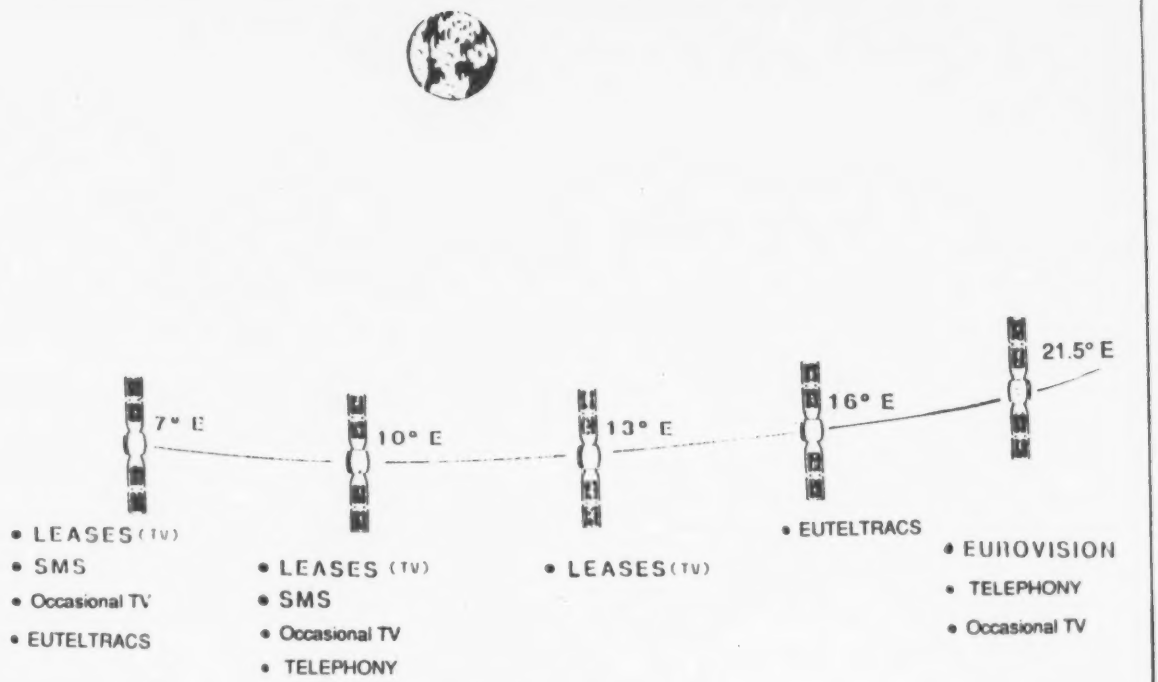


FIGURE 5 - THE EUTELSAT CONSTELLATION

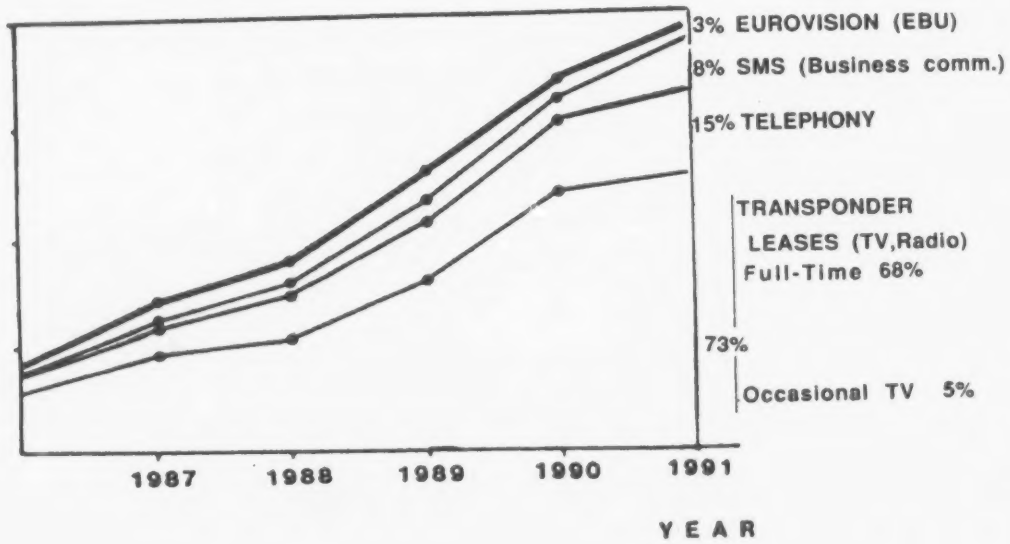


FIGURE 6 - EUTELSAT BUSINESS REVENUES

THE TONGASAT ASIA-PACIFIC REGIONAL SATELLITE COMMUNICATIONS NETWORK

DR. MATS C. NILSON, MANAGING DIRECTOR, TONGASAT, AND
MR. SIONE KITE, DEPUTY CHIEF SECRETARY AND DEPUTY SECRETARY TO CABINET, PRIME MINISTER'S OFFICE
KINGDOM OF TONGA

ABSTRACT

THIS PAPER DESCRIBES THE ADVANTAGES THAT ARE ENJOYED BY USERS OF THE TONGASAT ASIA-PACIFIC SATELLITE SYSTEM AND ILLUSTRATES THAT ALL COUNTRIES WITHIN THE COVERAGE AREA CAN PARTICIPATE, WITHOUT MAKING FINANCIAL CONTRIBUTIONS.

WITH RAPIDLY GROWING TRADE, AIR TRAFFIC AND TOURISM, THE ASIA-PACIFIC REGION OF THE WORLD IS EXPERIENCING ENORMOUS INCREASES IN THE NEED FOR SEVERAL TYPES OF TELECOMMUNICATIONS SERVICES. *THE ASIA-PACIFIC REGION COMPRISES WELL OVER 100 DISTINCT GEOGRAPHICAL JURISDICTIONS*, WITH A TOTAL POPULATION IN EXCESS OF THREE BILLION PEOPLE.

RURAL AND INTER-ISLAND COMMUNICATIONS REQUIREMENTS ARE OF INCREASING ECONOMIC IMPORTANCE TO A NUMBER OF COUNTRIES IN THE ASIA-PACIFIC REGION. THESE NEED TO BE SERVED VIA SATELLITE NETWORKS USING SMALL, INEXPENSIVE EARTH STATIONS (SOMETIMES CALLED "VSAT'S"). CABLE OR RADIO LINKS ARE TOO EXPENSIVE AND TAKE A LONG TIME TO CONSTRUCT.

IT IS ANTICIPATED THAT THE INTERNATIONAL TELECOMMUNICATIONS SATELLITE ORGANIZATION, INTELSAT, THE COMMERCIAL INTERNATIONAL SATELLITE OWNER AND OPERATOR ORGANIZATION, WHICH CURRENTLY ADMIRABLY PROVIDES NEARLY ALL INTERNATIONAL SATELLITE TELECOMMUNICATIONS TRAFFIC IN THE ASIA-PACIFIC REGION, MAY NOT BE ABLE TO SATISFY THE INCREASE IN DEMAND FOR TELECOMMUNICATIONS CAPACITY IN THAT REGION IN THE LATE 1990'S. IN PARTICULAR, INTELSAT WILL PROBABLY NOT BE ABLE TO ACCOMMODATE TRUE VSAT EARTH TERMINAL OPERATION THROUGHOUT THE ASIA-PACIFIC AREA.

COMPETITION IN TELECOMMUNICATIONS SERVICES HAS PROVEN BENEFICIAL TO END USERS AND CONSUMERS IN COUNTRIES WHERE COMPETITION HAS BEEN INTRODUCED. SUBSCRIBERS USUALLY BENEFIT IN TERMS OF LOWER PRICES FOR THEIR CALLS. IN ADDITION, ALTERNATE OR REDUNDANT PATH FACILITIES ARE VERY MUCH DESIRED BY MANY TELECOMMUNICATIONS CARRIERS, USERS, GOVERNMENT AGENCIES AND MILITARY THROUGHOUT THE WORLD.

FEATURES OF TONGASAT

- BROAD REGIONAL COVERAGE TO REACH HUGE MARKET AREA
- SAME EARTH STATIONS FOR DOMESTIC AND INTERNATIONAL TRAFFIC
- BY - PASS TERRESTRIAL NETWORK
- INEXPENSIVE SMALL COMMUNITY AND CUSTOMER PREMISE STATIONS (PARKING LOT, ROOF TOP, DRIVE-WAY)
- ACCESS FROM RURAL AREAS
- INTER-ISLAND COMMUNICATIONS
- CULTURAL/EDUCATIONAL TV DISTRIBUTION

Transportable Ku-Band Satellite Uplink Services

DUE TO THE ABOVE FACTORS, MOST FORESIGHTED TELECOMMUNICATIONS PLANNERS IN THE ASIA-PACIFIC REGION BELIEVE THAT ANOTHER SATELLITE SYSTEM IS NEEDED, CAPABLE OF SERVING THE WHOLE AREA, FROM THE SAUDI PENINSULA, IRAN AND PAKISTAN IN THE WEST TO HAWAII AND TAHITI IN THE EAST, AND FROM CHINA, KOREA, THE USSR AND JAPAN IN THE NORTH TO AUSTRALIA AND NEW ZEALAND IN THE SOUTH. ALL JURISDICTIONS IN BETWEEN THESE EXTREMES NEED OF COURSE ALSO BE SERVED, INCLUDING ALL OF THE PACIFIC ISLAND COUNTRIES AND TERRITORIES.

IN ADDITION, SOME BUSINESS AND GOVERNMENT CUSTOMERS IN THE ENTIRE REGION NEED DIRECT COMMUNICATIONS LINKS TO THE WEST COAST OF THE UNITED STATES AND TO EUROPE, EVEN FROM RURAL OR ISLAND AREAS, MOST OF WHICH HAVE NO SUCH LINKS TODAY.

DESIGNED AND PLANNED AS THE IDEAL ANSWER TO ALL THESE REQUIREMENTS, THE TONGASAT REGIONAL SYSTEM WILL PROVIDE THE ULTIMATE IN FLEXIBILITY FOR ANY USER IN THE ENTIRE ASIA-PACIFIC REGION. TONGA HAS REGISTERED WITH THE ITU/IFRB IN GENEVA A TOTAL OF SIX ORBITAL POSITIONS FOR THE REGIONAL SYSTEM NEEDS. THESE CAN ACCOMMODATE UP TO 20 SATELLITES TO MEET VARIOUS NETWORKING REQUIREMENTS.

ONE OF THE MAJOR ADVANTAGES INHERENT IN POSESSING SIX POSITIONS IS THAT *THE TONGASAT SYSTEM NOT ONLY WILL PROVIDE THE LUXURY OF SERVING THE WELL OVER 100 JURISDICTIONS WITHIN THIS VAST ASIA-PACIFIC AREA, BUT WILL ALSO PROVIDE IDEAL SATELLITE LOCATIONS FOR TRANS-PACIFIC LINKS AND FOR LINKS WITH EUROPE TO THE ASIA-PACIFIC REGION.*

TO ILLUSTRATE THIS, THE EAST TONGASAT ORBITAL POSITION IS IDEAL FOR NETWORKS SERVING PACIFIC ISLAND COUNTRIES AND FOR HIGH DENSITY TRAFFIC STREAMS BETWEEN THE WEST COAST OF THE UNITED STATES AND THE PACIFIC RIM COUNTRIES.

ANOTHER TONGASAT ORBITAL POSITION HAS BEEN CAREFULLY SELECTED TO *CONNECT TRAFFIC FROM EUROPE TO ALL ASIA-PACIFIC AND THE WESTERN PACIFIC RIM COUNTRIES, INCLUDING JAPAN AND THE WHOLE AUSTRALIAN CONTINENT.* MOST OTHER SATELLITES ARE NOT IN A POSITION TO COVER AUSTRALIA AND JAPAN, WHILE CONNECTING DIRECTLY WITH EUROPEAN COUNTRIES.

THE FOUR "CORE" ORBITAL POSITIONS OF TONGA HAVE BEEN VERY CAREFULLY SELECTED TO ENABLE THE TONGASAT REGIONAL SATELLITE SYSTEM TO REACH DIRECTLY TO HAWAII TO SERVE NORTH AMERICA, *INTERCONNECTING DIRECTLY WITH THE NORTH AMERICAN NETWORK*, WHILE THE SATELLITES WILL BE POSITIONED IN ORBIT IN SUCH A MANNER THAT THEY CAN SIMULTANEOUSLY SERVE THE WELL OVER 100 OTHER JURISDICTIONS IN ASIA-PACIFIC.

REALITY

TRADE IS GROWING

INTRA ASIA - PACIFIC NEED FOR TELECOMMUNICATIONS IS INCREASING

NEED FOR RURAL AREA COMMUNICATIONS IS URGENT

NO EXISTING SYSTEM CAPABLE OF PROVIDING LOW COST DATA COMMUNICATIONS

TOURISM IMPORTANT TO ECONOMIC GROWTH IN ASIA-PACIFIC

TOURISM IS MAJOR CONTRIBUTOR TO ECONOMIES

ASEAN COUNTRIES ALONE ESTIMATE 17 MILLION ARRIVALS IN 1990

ASEAN ANNUAL FOREIGN EXCHANGE RECEIPTS MORE THAN $15 BILLION

WORLD TOURISM WILL EXCEED 600 MILLION ARRIVALS BY YEAR 2000

TOURISTS WILL SPEND MORE THAN $500 BILLION/YEAR BY YEAR 2000

ASEAN - MALAYSIA, SINGAPORE, INDONESIA, THAILAND, PHILIPPINES, BRUNEI

THE TONGASAT ASIA PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM IS DESIGNED TO PROVIDE EITHER DOMESTIC OR INTERNATIONAL CAPACITY, IN ACCORDANCE WITH THE NEED OF EACH INDIVIDUAL COUNTRY. *IF A COUNTRY BEGINS WITH DOMESTIC SERVICES, THE SAME SMALL EARTH STATIONS ITS CARRIERS OR USERS INSTALL INITIALLY CAN LATER INTERCONNECT TO INTERNATIONAL DESTINATIONS VIA THE TONGASAT SATELLITES.* HERETOFORE, SEPARATE EARTH STATIONS HAVE BEEN NECESSARY, ADDING AN INFRASTRUCTURE EXPENSE BURDEN, WHICH WILL NO LONGER BE PRESENT OR REQUIRED WITH TONGASAT'S REGIONAL SYSTEM.

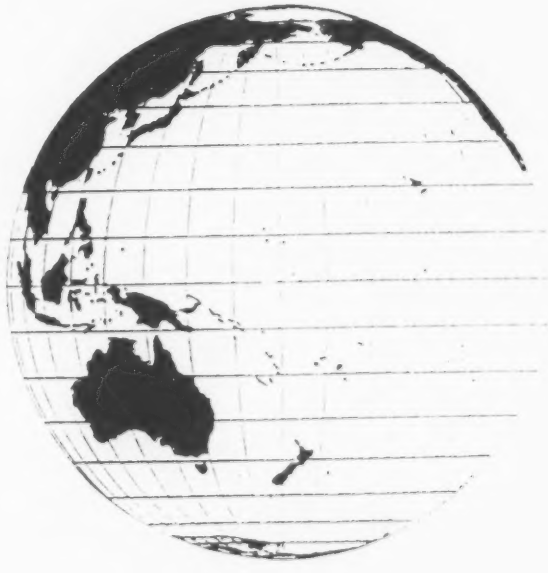
THE GOVERNMENT OF THE KINGDOM OF TONGA, AN INDEPENDENT, SMALL, NEUTRAL SOUTH PACIFIC ISLAND COUNTRY WITH A POPULATION OF ABOUT 100,000 IS FULLY SUPPORTING THE CREATION OF THE TONGASAT REGIONAL SYSTEM. TONGA FEELS THAT THE REGIONAL SYSTEM WILL BE OF BENEFIT TO ALL PARTICIPANTS.

IDEAL PARAMETERS

- HIGH ELEVATION ANGLES IN ASIA
- BROADEST GEOGRAPHICAL COVERAGE
- C-BAND FOR RAINY CLIMATES
- KU-BAND FOR SOME DOMESTIC USE
- HIGH POWER TO USE SMALL EARTH STATIONS
- ACCESS TO NORTH AMERICA VIA HAWAII

asia - pacific

THE EARTH AS SEEN BY THE TONGASAT SATELLITE AT 130 DEGREES EAST LONGITUDE



THE EARTH AS SEEN BY THE TONGASAT SATELLITE AT 171 DEGREES EAST LONGITUDE

WHY AN ASIA-PACIFIC SYSTEM?

WHY HAVE TONGA AND TONGASAT INVITED ALL THE TELECOMMUNICATIONS PROVIDERS IN ALL COUNTRIES OF THE ASIA-PACIFIC REGION TO PARTICIPATE IN THE USE AND OWNERSHIP OF A NEW SATELLITE SYSTEM FOR THE REGION?

WHY IS A NEW SATELLITE SYSTEM FOR THE ASIA-PACIFIC REGION SO DESIRABLE?

BECAUSE:

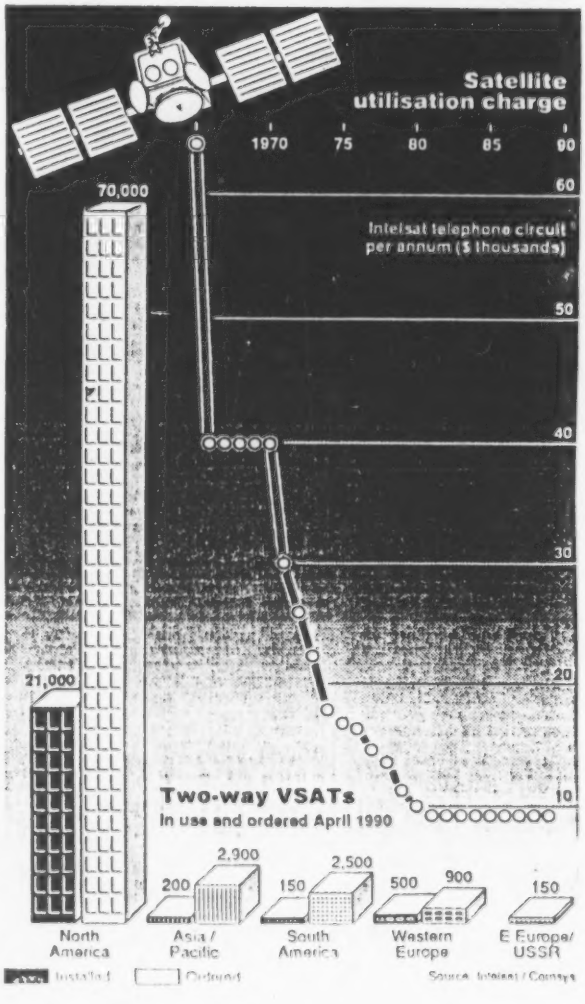
--THE ASIA-PACIFIC REGION IS DEPRIVED IN TERMS OF SATELLITE TELECOMMUNICATIONS, ESPECIALLY WHEN COMPARED TO NORTH AMERICA, SOUTH AMERICA AND TO EUROPE. SATELLITE COMMUNICATIONS LINKS ARE VERY LIMITED BY COMPARISON TO THE RELATIVE POPULATIONS OF THESE PARTS OF THE WORLD. SMALL EARTH STATION (VSAT) SATELLITE NETWORKS ARE NOT WIDESPREAD IN THE ASIA-PACIFIC AREA, PARTLY DUE TO OVER-REGULATION BY GOVERNMENTS, PREVENTING THE CREATION OF OPTIMIZED REGIONAL INTERNATIONAL SYSTEMS, RESULTING IN LACK OF SUITABLE SATELLITE CAPACITY. AN ARTICLE IN THE LONDON FINANCIAL TIMES OF 17 JULY 1990 POINTS OUT THAT *THE NUMBER OF SATELLITE VSAT TERMINALS IN USE AND ORDERED FOR INSTALLATION IN THE ASIA-PACIFIC REGION IS DIRECTLY INVERSE TO THE RELATIVE POPULATIONS, WHEN COMPARED TO NORTH AMERICA AND EUROPE.*

--IN FACT, *NOT ONLY IS THE COMPARATIVE VSAT POPULATION INVERSE TO THE PEOPLE POPULATION, BUT SO IS THE NUMBER OF SATELLITE TRANSPONDERS IN USE IN THE ASIA-PACIFIC REGION WHEN COMPARED TO THE POPULATION* OF NORTH AMERICA -- ANOTHER FACTOR CONTRIBUTING TO LIMITING THE GROWTH OF INDUSTRY, TOURISM, TRADE AND GNP IN ASIA-PACIFIC. *THE REGION IS IN NEED OF MORE TELECOMMUNICATIONS FACILITIES TO PROMOTE GROWTH IN THESE IMPORTANT AREAS OF DEVELOPMENT.*

--SOME ASIA-PACIFIC COUNTRIES HAVE TREMENDOUS PROBLEMS COPING WITH THE OVER-CROWDING OF THEIR CAPITAL AND OTHER LARGE CITIES. THE TONGASAT REGIONAL COMMUNICATIONS SYSTEM CAN HELP STOP AND EVEN REVERSE THIS RELENTLESS MIGRATION FROM THE RURAL AND ISLAND AREAS. GOOD COMMUNICATIONS WILL ENABLE FACTORIES, REGIONAL OFFICES AND TRADING COMPANIES AND VARIOUS INDUSTRIES TO RE-LOCATE IN THE COUNTRY-SIDE. PLANTATIONS AND FISH FARMS CAN FLOURISH. EMPLOYERS BENEFIT BY HIRING HONEST AND HARD WORKING RURAL LABOR AND BY HAVING RELIABLE COMMUNICATIONS.

--ONE OF THE FOREMOST REASONS IS THAT MANY NATIONS IN THE ASIA-PACIFIC COVERAGE AREA HAVE REQUIREMENTS FOR RURAL OR INTER-ISLAND TELECOMMUNICATIONS LINKS THAT CANNOT ECONOMICALLY AND QUICKLY AND EASILY BE IMPLEMENTED WITHOUT POWERFUL COMMUNICATIONS SATELLITES, WHICH PERMIT SMALL AND INEXPENSIVE EARTH STATIONS (VSAT'S) TO BE USED, EITHER FOR DOMESTIC OR FOR INTERNATIONAL PURPOSES.

FINANCIAL TIMES TUESDAY JULY 17 1990



--AN IMPORTANT REASON IS THAT IT IS OF ADVANTAGE TO CARRIERS OR PROVIDERS OF COMMUNICATIONS LINKS TO HAVE AVAILABLE "ALTERNATE FACILITIES", ESPECIALLY FOR INTERNATIONAL LINKS. THIS "PATH DIVERSITY" IS ALSO OFTEN OF INTEREST TO MILITARY AUTHORITIES.

COMPETITION IN THE PROVISION OF TELECOMMUNICATIONS CARRIERS AND THEIR FACILITIES HAS ALWAYS RESULTED IN BENEFITS TO THE END-USERS OF COMMUNICATIONS IN THOSE COUNTRIES WHERE SUCH COMPETITION HAS BEEN INTRODUCED. NORMALLY, END USER CHARGES ARE LOWERED AS COMPETITION IS INTRODUCED.

--MOST POWERFUL OF ALL REASONS IS PERHAPS THAT A UNITED APPROACH OF SEVERAL COUNTRIES WILL TAKE ADVANTAGE OF THE ECONOMY OF SCALE SO NECESSARY TO MAKE VIABLE A COMMUNICATIONS SYSTEM COSTING HUNDREDS OF MILLIONS OF US DOLLARS.

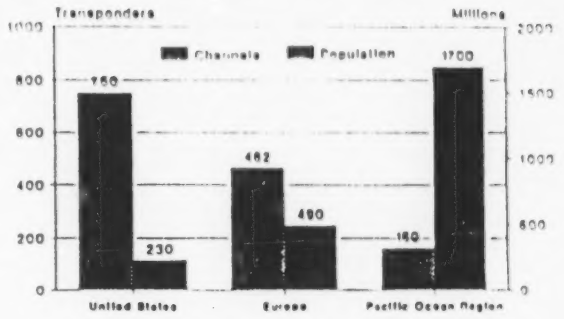
--NOT LEAST IS THE REASON THAT INTELSAT, WHICH ADMIRABLY PROVIDES SATELLITE COMMUNICATIONS SERVICES TO MOST OF THE WORLD'S NATIONS, MAY NOT BE ABLE TO PROVIDE ENOUGH SATELLITE CAPACITY OF THE TYPE NECESSARY TO SERVE THE GROWING NEEDS OF THE ASIA-PACIFIC REGION IN THE LATE 1990'S, PARTICULARLY NOT TO THOSE COMMERCIAL AND GOVERNMENTAL USERS IN EACH COUNTRY THROUGHOUT THE ASIA PACIFIC REGION, WHO WISH TO EMPLOY THEIR OWN SMALLER CUSTOMER PREMISE OR COMMUNITY EARTH STATIONS (VSAT'S). THIS IS BECAUSE INTELSAT SATELLITES WERE NOT OPTIMIZED FOR, AND ARE THEREFORE NOT ECONOMICAL FOR, USE WITH SUCH SMALL EARTH STATIONS.

--THERE WILL BE AMPLE DEMAND DURING THE 1990'S TO WARRANT INTRODUCTION OF A SECOND SATELLITE NETWORK, WHICH WILL ALSO SERVE TO PROVIDE ALTERNATIVE COMMUNICATIONS FACILITIES TO END-USERS OF PARTICIPATING NATIONS IN THE REGION.

--THERE IS NEED FOR ADDITIONAL CAPABILITY TO REACH OUTLYING ISLANDS OR RURAL AREAS WITH CULTURAL AND EDUCATIONAL TV, ENTERTAINMENT AND NEWS TV PROGRAMMING, USING SMALL, INEXPENSIVE TV RECEIVE EARTH STATIONS (TVRO'S).

--FINALLY, THE ECONOMIC ADVANTAGES TO SUBSCRIBERS AND BUSINESS END-USERS OF ELIMINATING IN MOST INSTANCES THE EXPENSIVE LAND-LINE CONNECTIONS TO REACH DISTANT EARTH STATIONS IS VERY IMPORTANT IN SOME COUNTRIES. AS AN EXAMPLE, FOR USERS WITH HIGH DATA RATE DIGITAL DATA TRANSMISSION REQUIREMENTS, DOMESTIC TERRESTRIAL MICROWAVE OR RADIO RELAY FACILITIES ARE OFTEN EITHER NOT CAPABLE OF SUCH TRANSMISSIONS OR THEY ARE NON-EXISTENT.

Transponder/Population



ASIA-PACIFIC " MEGA - CITIES "
FACE BIG PROBLEMS

WORSENING POLLUTION AND CRUSHING POPULATION GROWTH

URBAN POPULATION GROWTH OF 3% TO 6.5% PER YEAR - 3 TIMES FASTER THAN IN VILLAGES

BY 2020 HALF OF ASIA-PACIFIC POPULATION IN " MEGA - CITIES "

BY 2000 ASIA-PACIFIC URBAN POPULATION 1.157 BILLION PEOPLE

18 " MEGA - CITIES " OF 4 MILLION OR MORE IN 1990

52 " MEGA - CITIES " IN ASIA-PACIFIC BY YEAR 2025

UNEMPLOYMENT, GARBAGE, SMOG, LEAD, CARBON, SULPHUR DIOXIDE

ADVANTAGES OF TONGASAT

AN INTERNATIONAL PARTNERSHIP CALLED THE "INTERNATIONAL OWNERSHIP BODY, (IOB)", WILL OWN AND OPERATE THE REGIONAL SATELLITE SYSTEM USING THE SIX ORBITAL POSITIONS OF THE KINGDOM OF TONGA. TONGASAT WILL OWN 10% OF THE IOB, AND THE REMAINING PARTNERS 90%. THUS NEITHER TONGA NOR TONGASAT ARE DOMINANT IN THE IOB.

PARTICIPATION IS VERY FLEXIBLE. IOB PARTNERS MAY BE COMMERCIAL OR GOVERNMENTAL ORGANIZATIONS. THEY CAN BE INVESTORS WHICH ARE NOT SIGNATORIES. ALTHOUGH MOST ARE EXPECTED TO BE SIGNATORIES, IT SHOULD BE CLEAR THAT INVESTORS NEED NOT BE SIGNATORIES OF PARTICULAR COUNTRIES. FURTHERMORE, A SIGNATORY, WHICH IS APPOINTED THE FRANCHISEE LICENSED TO CARRY TRAFFIC IN AND OUT OF ITS COUNTRY, CAN BE A NON-INVESTING SIGNATORY.

INITIAL INVESTMENTS NEED COVER INITIAL PAYMENTS FOR CONTRACTS. THE IOB PARTNERS WILL HAVE THE LUXURY OF BEING ABLE TO PHASE THEIR TOTAL CAPITAL COMMITTMENTS AS FUNDS ARE REQUIRED FOR SATELLITE AND LAUNCH SERVICES CONTRACTS OVER 1992 TO 1996, FOR THE FIRST GENERATION OF THREE SATELLITES.

THUS, RELATIVELY LOW INITIAL INVESTMENTS ON THE PART OF THE IOB PARTNERS WILL RESULT IN THE FOLLOWING ADVANTAGES, BY JOINING THE TONGASAT REGIONAL SYSTEM VERSUS JOINING OTHER POTENTIAL SYSTEMS VYING FOR A ROLE IN THE ASIA-PACIFIC REGION OR FOR THE PACIFIC RIM COUNTRIES:

- TONGASAT GUARANTEES *MAXIMUM FLEXIBILITY* OF PLACEMENT OF FUTURE SATELLITES, DUE TO AVAILABILITY OF SIX ORBITAL POSITIONS OF TONGASAT, ABLE TO ACCOMMODATE UP TO 20 "LIGHT-SATS" OR UP TO 12 MEDIUM WEIGHT SATELLITES -- WHICH IN TURN PROVIDES THE *ABILITY TO MEET ANY CUSTOMER REQUIREMENTS* THROUGHOUT THE ASIA-PACIFIC REGION, DUE TO THE GEOGRAPHICAL PLACEMENT POSSIBILITES OF SATELLITES

- THE IOB PROVIDES FOR SHARING OF THE INVESTMENT CAPITAL REQUIRED WITH NEW PARTNERS ACCEPTABLE TO THE INITIAL PARTNERS AND TO TONGASAT

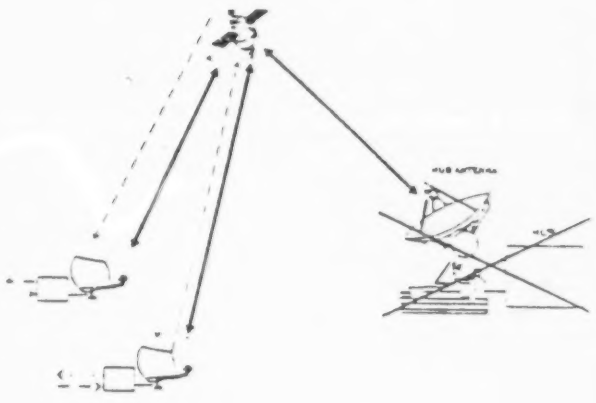
- THE INITIAL CAPITAL INVESTMENT OF THE FIRST IOB PARTNERS, FOR 90% OF THE IOB PARTNERSHIP, OR SMALLER PERCENTAGES THEREOF, CAN BE SOLD TO OTHER ENTITIES THAT WISH TO BECOME PARTNERS IN OR INVESTING SIGNATORIES TO THE IOB, DURING THE SATELLITE CONSTRUCTION PERIOD, OR THEREAFTER, WITH PROBABLE LARGE PROFITS TO THE INITIAL PARTNERS

- PROVIDERS OF NETWORK SERVICES, DOMESTIC SATELLITE SERVICES, TV DISTRIBUTION, RADIO NETWORKS, CNN, BBC, ASIAN TV NETWORKS, CABLE SYSTEMS, VALUE ADDED NETWORKS, MULTINATIONAL COMPANIES, BANKS, FINANCIAL INSTITUTIONS, GOVERNMENT AGENCIES AND THE MILITARY, ETC. WILL JOIN THE TONGASAT SYSTEM, BECAUSE OF ITS VAST COVERAGE AND NUMBER OF SATELLITE POSITIONS. IN DOING SO, THEY *TAKE ADVANTAGE OF THE ECONOMY OF SCALE*, ASSURING BETTER:

  - SPARING IN ORBIT - OUTAGE PROTECTION
  - COVERAGE FLEXIBILITY
  - CONTINUED GROWTH
  - POSSIBILITY OF USING ALTERNATIVE PATHS
  - REDUNDANCY IN LARGER SATELLITES

- IN ADDITION TO THE *OPTIMUM COVERAGE OF FOUR "C-SAT"*

VSAT to VSAT Direct



VSATs

NO "HUBBING" OF V-SAT TRAFFIC

400

ORBITAL POSITIONS IN THE 130.0E TO 142.5E ARC, WITH HIGH ELEVATION ANGLES SPANNING OVER THE CENTERS OF POPULATION OF CHINA, JAPAN AND THE USSR IN THE NORTH TO AUSTRALIA IN THE SOUTH, PLUS COVERING FROM THE ARABIAN GULF IN THE WEST TO HAWAII AND TAHITI IN THE EAST, ALL INTERCONNECTED DIRECTLY TO THE NORTH AMERICAN NETWORKS VIA HAWAII, THE TONGASAT SYSTEM OFFERS ADDITIONAL SATELLITE POSITION ADVANTAGES:

- INTERCONNECTION WITH ALL COUNTRIES IN THE ENTIRE WESTERN PACIFIC RIM, DIRECTLY FROM THE WEST COAST OF THE UNITED STATES, THROUGH THE USE OF THE 170.75E POSITION IN C-BAND AND

- *PROVISION OF THE HIGHEST POSSIBLE ELEVATION ANGLES FOR THE PACIFIC AREA* THROUGH THE USE OF THE 170.75E C-BAND POSITION

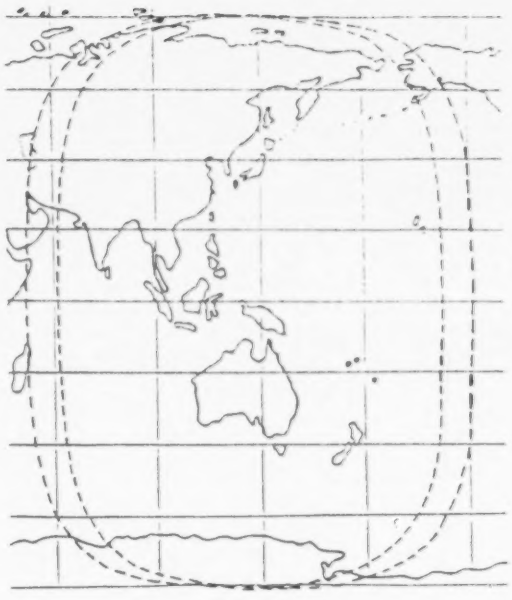
- INTERCONNECTION WITH EUROPE DIRECTLY FROM ALL WESTERN PACIFIC RIM COUNTRIES, *INCLUDING JAPAN AND THE WHOLE AUSTRALIAN CONTINENT*, AND FROM ALL COUNTRIES BETWEEN EUROPE AND THE WESTERN PACIFIC RIM NATIONS, VIA THE USE OF THE 83.3E POSITION IN Ku-BAND

- BEST POSSIBLE HIGH EARTH STATION ELEVATION ANGLES IN EAST ASIA/AUSTRALIA/NEW ZEALAND/PNG/CHINA/TAIWAN/JAPAN/HK AND IN THE PHILIPPINES FOR BUSINESS COMMUNICATIONS SYSTEMS USING SMALL EARTH STATIONS -- *MAKES INSTALLATION OF EXTENSIVE NETWORKS FAR LESS EXPENSIVE THAN IF SATELLITES ARE LOCATED FAR TO THE WEST OR FAR TO THE EAST IN ORBIT* -- EASES INSTALLATION OF THOUSANDS OF EARTH STATIONS

- *ECONOMY OF SCALE, BOTH IN TERMS OF SPACE SEGMENT AND GROUND SEGMENT, WILL EVENTUALLY ENABLE THE TONGASAT ASIA-PACIFIC REGIONAL SYSTEM TO PROVIDE SERVICES AT A LOWER COST* THAN SYSTEMS COMPRISED OF ONLY TWO ORBITAL POSITIONS -- WHICH IN TURN WILL MAKE CUSTOMERS MIGRATE TO THE TONGASAT SYSTEM -- BECAUSE OF

  - AVAILABILITY OF SIX ORBITAL POSITIONS
  - LOWER SATELLITE COST DUE TO MULTIPLE PROCUREMENT
  - VAST COVERAGE AREA AT HIGH EIRP'S
  - LOWER TARIFFS
  - BETTER ELEVATION ANGLES FOR EXTENSIVE NETWORKS
  - ABILITY TO EMPLOY VERY SMALL TVRO'S
  - MAXIMUM IN-ORBIT SPARING PROTECTION
  - ALTERNATIVE PATH POSSIBILITIES (MANY SATELLITES)
  - AVAILABILITY OF BOTH C- AND Ku-BAND
  - LOWER TRANSPONDER-YEAR UNIT COST
  - HIGHER RELIABILITY AND LONGER LIFE OF LARGER SATELLITES
  - CONVENIENT NEWS FEEDS AND MILITARY USES OF SMALL, TRANSPORTABLE EARTH STATIONS
  - USE OF VSAT EARTH STATIONS WITHOUT "HUBBING"
  - LESS EXPENSIVE INSTALLATION OF EXTENSIVE

TONGASAT "CORE" COVERAGE



130.0E - 142.5E
(RANGE OF 4 ORBITAL POSITIONS)

EACH SATELLITE USES SEVERAL BEAMS WITHIN ITS COVERAGE

High EIRP's

Beam	C-Band	Ku-Band
Japan/China Beam	42.0 dBW	51.7 dBW
Malay Beam	40.9 dBW	50.5 dBW
Southern Beam	37.7 dBW	45.4 dBW
US Beam	41.1 dBW	54.8 dBW
Pacific Beam	38.9 dBW	--

NETWORKS, DUE TO HIGH ELEVATION ANGLES

- *THE SIX TONGASAT SATELLITE ORBITAL POSITIONS WERE CAREFULLY SELECTED* TO ASSURE SUCCESSFUL COORDINATION WITH COUNTRIES HOLDING SATELLITE ORBITAL LOCATIONS IN NEIGHBORING ORBIT LONGITUDES, *WHILE PRESERVING TOTAL GLOBAL COVERAGE AS SEEN FROM EACH SATELLITE AND HIGH POWER LEVELS FOR SMALL EARTH STATIONS* -- THE TONGASAT SATELLITES ARE ALLOWED TO OPERATE AT THE HIGHEST PERMISSIBLE FLUX DENSITY LEVELS, IN ACCORDANCE WITH THE RADIO REGULATIONS. MOST OTHER SATELLITE POSITIONS REGISTERED BY OTHER COUNTRIES IN THE ORBITAL ARC OF INTEREST ARE NOT AUTHORIZED TO OPERATE AT MAXIMUM PERMISSIBLE LEVELS, AND ARE NOT ALLOWED TO ILLUMINATE THE WHOLE EARTH AS SEEN FROM EACH SATELLITE.

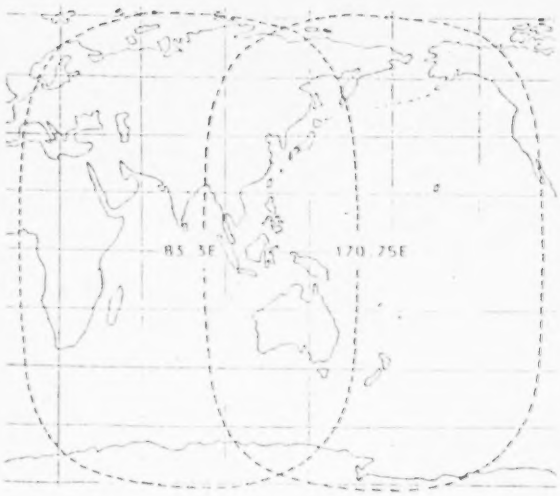
- IT IS OF CRUCIAL IMPORTANCE TO RECALL THAT THE TONGASAT ALTERNATIVE PROVIDES *MORE ORBITAL POSITIONS THAN ANY OTHER IN THE ASIA-PACIFIC REGION,* AND THAT THE ORBIT POSITIONS REGISTERED ARE ALREADY IN THE IFRB "COORDINATION" STAGE WITH OTHER COUNTRIES, WITH THE KIND ASSISTANCE OF THE IFRB/ITU IN GENEVA.

- IT IS ALSO OF GREAT IMPORTANCE TO RECOGNIZE THAT THE GOVERNMENT OF THE KINGDOM OF TONGA IS FULLY IN SUPPORT OF THE TONGASAT REGIONAL SYSTEM. THE GOVERNMENT OF THE KINGDOM HAS ISSUED DIPLOMATIC AND OTHER GOVERNMENT-TO-GOVERNMENT INVITATIONS TO OTHER COUNTRIES, INVITING THE OTHER GOVERNMENTS TO ALLOW SIGNATORIES/ENTITIES TO CARRY TRAFFIC IN AND OUT OF THEIR RESPECTIVE COUNTRIES. *NO SATELLITE SYSTEM IS ATTRACTIVE TO CUSTOMERS UNTIL SUCH "LANDING RIGHTS" ARE OBTAINED IN EACH COUNTRY PARTICIPATING IN A NETWORK.*

EXISTING SATELLITE SYSTEMS OVER THE ASIA-PACIFIC AREA ARE NOT IN A POSITION TO PROVIDE THE SAME EXTENSIVE COVERAGE AND INTERCONNECTIVITY AS TONGASAT. THEY HAVE ONLY TWO OR THREE ORBITAL POSITIONS EACH. THE INDONESIAN PALAPA SYSTEM IS TOO FAR WEST IN ORBIT TO BE ABLE TO INTERCONNECT DIRECTLY WITH NORTH AMERICA. THE ASIASAT SATELLITE IS LIKEWISE TOO FAR WEST IN ORBIT. VARIOUS DOMESTIC SYSTEMS MAY NOT EXPAND THEIR COVERAGE AREAS TO PROVIDE REGIONAL SERVICES, DUE TO THEIR INITIAL IFRB AUTHORIZATIONS. IF THEY ATTEMPT TO EXPAND, THEY LIKELY WILL NOT BE ABLE TO COORDINATE SUCCESSFULLY WITH NEIGHBORING SATELLITES.

ASPIRING TO OPERATE SYSTEMS OVER ASIA OR THE PACIFIC ARE PACSTAR AND PANAMSAT. THEY HAVE SATELLITE ORBITAL POSITIONS TOO FAR TO THE EAST AND/OR TOO FAR TO THE WEST TO PROVIDE IDEAL ELEVATION ANGLES FOR THE MAJORITY OF POPULATION CONCENTRATIONS IN EAST ASIA AND AUSTRALASIA, WHERE THE MAJOR POPULATIONS ARE CONCENTRATED. THUS TONGASAT IS THE ONLY ENTRANT WITH POSITIONS IN THE 130.0E - 142.5E LONGITUDE ORBITAL ARC, ESTABLISHING A REGIONAL SYSTEM.

"EAST" AND "WEST" TONGASAT COVERAGE



EARTH STATION SIZES

FOR TV BROADCAST QUALITY DISTRIBUTION	2 - 3 METER
RADIO DISTRIBUTION	1 - 2 METER
2-WAY LOW SPEED DATA	1 - 2 METER
TELEPHONY	2 - 3 METER
DATA HIGH SPEED	2 - 3 METER
VIDEO CONFERENCING	2 - 3 METER
HOME TV RECEPTION	1 - 2 METER
TV UPLINKING	4 5 METER

DIRECT REMOTE - TO - REMOTE TRAFFIC WITHOUT USING A "HUB" STATION

NOTE DEPENDS ON COVERAGE BEAM

TONGASAT IDEAL FOR ASIA - PACIFIC

O HIGH ELEVATION ANGLES

O HIGH POWER SATELLITES

O USE VSAT's W/O "HUBBING"

INSTITUTIONAL ARRANGEMENTS

I. REGULATORY ASPECTS

User access to the Tongasat satellite network is of course left for each country to regulate. In particular, for international links, each government can decide which alternative is best for its telecommunications carriers and users: Either the respective governments may wish to permit their users of the Asia-Pacific regional system to have direct access to the satellites from their small customer owned earth stations ... Or each government may wish to permit government owned or franchised communications carrier owned earth stations to be installed on or near customer premises ... Or installed in every community, so that long distance, costly links through the terrestrial networks are not necessary. *To make the maximum economic savings possible for the users, the government may wish to permit direct access to the satellites by such customer premise or community earth stations,* by-passing the existing terrestrial network entirely, especially in rural areas.

It is likewise a matter of course that each government dictate *either that the private sector be allowed to provide a Signatory to the system ownership consortium, the "International Ownership Body (IOB)", or that the Signatory be a Government Agency, or to let the Signatory of another country represent it.* One large telephone company or VAN carrier, or consortiums of carriers or cellular or telephone companies may wish to form a Signatory of one country, while the single national telecommunications provider of another country acts as its Signatory to the IOB. The IOB is an international partnership owned by Investors and Investing Signatories.

Finally, the regulatory body of each nation may wish to impose tariffs, rules or restrictions on the resale by its Signatory of circuits or transponders, to the communications users in that country or its territories. *Tonga and Tongasat urge nations to stimulate as much as possible the establishment of a Signatory to the Tongasat Regional System, for the good of its end-users, by not imposing rules that would unduly limit the net earnings of the Signatory.* Each Signatory will surely make its offerings to end-users as attractive as possible, in order to maximize revenues, since the Signatory will in most cases compete with other providers of international links, via satellite or cable. Likewise, each Signatory will strive to provide various services desired by its subscribers or customers. (The same applies to a great extent to Signatories of INTELSAT, in that their end user tariffs must successfully compete with alternate means.)

REGULATORY & INSTITUTIONAL

- GOVERNMENTS ALLOW USER ACCESS
- BY-PASS LONG LAND-LINES
- COMMUNITY OR CUSTOMER PREMISE EARTH STATIONS
- EACH COUNTRY DESIGNATE SIGNATORY
  - GROUP OF COMMERCIAL CARRIERS
  - GOVERNMENT ENTITY
- GOVERNMENTS REGULATE TARIFFS
- SIGNATORIES TO REGIONAL SYSTEM SET CHARGES TO RETURN 14% - 22%

LEGAL/REGULATORY ASPECTS

- TONGA HAS RIGHT TO USE EACH SATELLITE POSITION PROVIDED SATELLITE LAUNCHED BY 1999 INTO EACH POSITION
- IN ACCORDANCE WITH RADIO REGULATIONS ALL LEGAL MATTERS FINISHED, EXCEPT FOR TECHNICAL COORDINATION WITH OTHER COUNTRIES
- COORDINATION WITH INTELSAT RE ECONOMIC HARM WILL TAKE PLACE AFTER IOB ESTABLISHED
- EACH COUNTRY MAY PERMIT CARRIER ACCESS OR APPOINT SIGNATORY (EXCLUSIVE)
- NO FCC INVOLVEMENT, EXCEPT IN USA

IOB - INTERNATIONAL OWNERSHIP BODY

II. OWNERSHIP AND ORGANIZATION

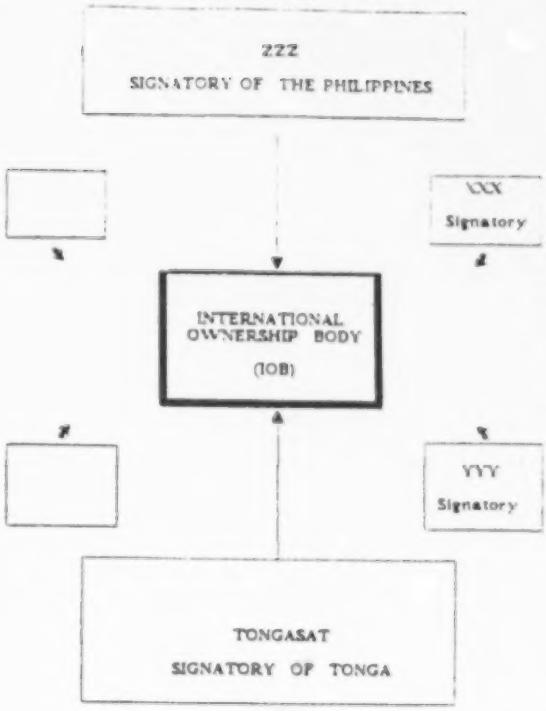
THE IOB WILL BE A TRULY COOPERATIVE INTERNATIONAL PARTNERSHIP. THE FUNCTIONING OF THE IOB IS SOMEWHAT SIMILAR TO THE INTELSAT AND THE EUTELSAT OPERATING AGREEMENTS. IT WILL HAVE A SINGLE TIER STRUCTURE, SINCE NO GOVERNMENT PARTIES NEED BE INVOLVED, ONLY PRIVATE OR GOVERNMENT SIGNATORIES AND INVESTORS/PARTNERS. ALSO, INSTEAD OF THE NECESSITY OF HAVING INVESTING SIGNATORIES REPRESENTING EACH COUNTRY (AS IN INTELSAT), A COUNTRY CAN APPOINT A NON-INVESTING SIGNATORY, OR LET A SIGNATORY OF ANOTHER COUNTRY REPRESENT ITS INTERESTS IN MEETINGS OF THE IOB.

IT IS LIKELY THAT A SMALLER GROUP OF PRIVATE OR GOVERNMENTAL INVESTING ENTITIES, SOME BUT NOT ALL OF WHICH ARE FRANCHISED BY THEIR RESPECTIVE GOVERNMENTS AS INVESTING SIGNATORIES, WILL OWN AND OPERATE THE SYSTEM TOGETHER WITH TONGASAT. NON-INVESTING SIGNATORIES WILL BE ENTITLED TO OBSERVER STATUS ON THE IOB. PARTICIPATING NATIONS' REGULATORY AUTHORITIES OR THEIR SIGNATORIES WILL OF COURSE SET THE TARIFFS CHARGED TO END-USERS IN THEIR RESPECTIVE COUNTRIES.

THIS OWNERSHIP STRUCTURE PROVIDES AN ADVANTAGE TO COUNTRIES HAVING NO INTERESTED INVESTOR. IT PERMITS A SMALLER GROUP OF FINANCIERS FROM SOME OF THE PARTICIPATING COUNTRIES TO EARN A REASONABLE AND ATTRACTIVE RETURN ON INVESTMENT, WHILE EACH AND EVERY PARTICIPATING COUNTRY CAN AVAIL ITS USERS OF THE COMMUNICATIONS SERVICES, *WITHOUT THE NECESSITY OF GOVERNMENTAL OR PRIVATE SECTOR INVESTMENT FROM AN ENTITY IN THAT COUNTRY.* INDIVIDUAL USERS OR CARRIERS OR THE SIGNATORY IN EACH COUNTRY NATURALLY NEED TO FINANCE THEIR EARTH STATIONS AND PAY FOR THE SATELLITE CAPACITY THEY USE.

THUS, NO COUNTRY NEEDS TO BE LEFT OUT BECAUSE OF FINANCIAL CONSIDERATIONS.

TO SUMMARIZE, EACH PARTICIPATING COUNTRY NEEDS ONLY TO LICENSE OR FRANCHISE OR APPOINT A SIGNATORY TO THE IOB, WHETHER AN INVESTING OR NON-INVESTING SIGNATORY, WHICH IS THE CARRIER OF TRAFFIC IN AND OUT OF THAT COUNTRY ON THE TONGASAT REGIONAL SYSTEM. THERE IS NO FINANCIAL COMMITMENT BY THE GOVERNMENT. SIGNATORIES CAN BE COMPOSED OF ANY ENTITIES EACH GOVERNMENT CHOOSES TO PERMIT TO PROVIDE THE DIRECT ACCESS TO THE TONGASAT ASIA-PACIFIC REGIONAL SATELLITES. THEY CAN BE PRIVATE, COMMERCIAL OR GOVERNMENTAL ORGANIZATIONS, AND THEY CAN BE FINANCIER OR USER ENTITIES. A COUNTRY MAY APPOINT AN INVESTOR OR SIGNATORY OF ANOTHER COUNTRY TO REPRESENT IT IN THE IOB, WHILE ALSO LICENSING THAT SIGNATORY, OR FRANCHISING ANOTHER DOMESTIC ENTITY, TO CARRY THE TRAFFIC IN AND OUT OF ITS TERRITORY.



INTERNATIONAL OWNERSHIP BODY (IOB)
FINANCIAL/INSTITUTIONAL ASPECTS

- ANY ENTITY CAN PARTICIPATE IN FINANCING OF IOB TOTAL SYSTEM
- PREFER 5 TO 10 INVESTORS FOR ENTIRE $400 - $600 MILLION IOB SYSTEM – REAP ROI OF 14% - 26%
- EACH COUNTRY MAY APPOINT SIGNATORY
  - EITHER INVESTOR IN IOB
  - OR NON-INVESTING CARRIER'S CARRIER OR GROUP OF CARRIERS
  - OR EACH END USER AUTHORIZED TO DEAL DIRECTLY WITH IOB
  - OR GOVERNMENT ENTITY
- TONGASAT UNDER CONTRACT AS INITIAL SYSTEM MANAGER
- ANY INVESTING SIGNATORY COULD PROVIDE TT&C

FINANCIAL CONSIDERATIONS

The total cost of satellite procurement and launching of the initial Tongasat Regional System is of course dependent on the type and number of satellites selected. The cost range for the first generation of satellites is estimated to be from US$350 million consisting of a 2 satellite system of relatively simple satellites with limited capacity, to about US$600 million or more for a 3 - 4 satellite system of a relatively complex nature. These figures include a TT&C station and insurance.

Earth stations in each country are of course an investment made by either authorized carriers or by each customer or by the Signatory to the "IOB" or Investor of that country.

An initial complement of two medium capacity satellites can be launched for a total cost in orbit of about US$300 million. In any case, follow-on satellites will probably be more complex or heavy, with hybrid C- and Ku-band high power transponder payloads, to satisfy the growing demand for capacity during the next century.

It is therefore the aim of the Government of Tonga and Tongasat to work together with all nations willing to franchise an entity to participate, in order to take advantage of the economy of scale, so necessary to finance and make commercially attractive a regional satellite system. The IOB will be an international partnership of Signatories and Investors, exercising maximum corporate type of efficiency, resulting in lowest costs for all.

Investors of the IOB can expect an annual Return On Investment (ROI) in the 14% - 22% range. *Most Signatories will of course earn far more on the re-sale to carriers or end-users of the capacity the Signatories purchase at whole sale prices from the IOB.* That is, for example, how the Signatories of INTELSAT experience very good revenues and net earnings.

Typical private Investors in the IOB Regional System may include authorized communications providers, telephone companies, television and radio networks/broadcasters, cultural and educational television providers, government franchised communications carriers, carriers' carriers, satellite manufacturers, earth station and launch vehicle manufacturers, banks, venture capitalists, multi-national and trading companies, value added networks (VANS), cable TV system operators, discount telephone carriers, etc.

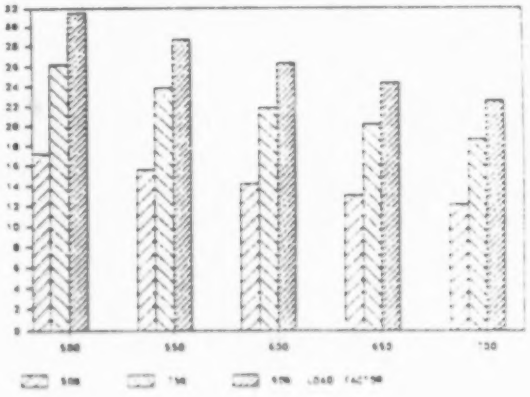
The TT&C station can be located in any country that is represented by a significant Investor or Investing Signatory, subject to approval of all then current Investing Signatories and Investors which are not Signatories.

TYPICAL FINANCIERS

- COMMUNICATIONS CARRIERS
- TELEPHONE COMPANIES
- TV & RADIO NETWORKS
- PT & T
- MULTI - NATIONAL COMPANIES
- BANKS, FINANCIAL INSTITUTIONS
- MANUFACTURERS OF SATELLITES, LAUNCH VEHICLES AND EARTH STATIONS
- TV CABLE NETWORKS

RETURN ON INVESTMENT OF INTERNATIONAL OWNERSHIP BODY

3 C/KU-BAND SATELLITES



ANNUAL ROI VS TOTAL INVESTMENT IN US$ MILLIONS
FOR LOAD FACTORS OF 50% 75% AND 90%

CONCLUSIONS

THE KINGDOM OF TONGA AND TONGASAT INVITE AND URGE INTERESTED END-USERS, TELEPHONE COMPANIES, CELLULAR TELEPHONE OPERATORS, VALUE ADDED NETWORKS, TV AND RADIO BROADCASTERS, COMMERCIAL CARRIERS AND OTHER TELECOMMUNICATIONS FACILITY PROVIDERS TO EXPRESS THEIR VIEWS CONCERNING PARTICIPATION OF THEIR USERS AND SUBSCRIBERS IN THE FORM OF FRANCHISING AN ENTITY TO CARRY TRAFFIC IN AND OUT OF THEIR COUNTRY. WE APPEAL TO INTERESTED PARTIES TO OBTAIN SUCH PERMISSION THROUGH THEIR APPROPRIATE GOVERNMENT INSTANCES. NO NATION CAN AFFORD TO BE LEFT OUT.

TONGA AND TONGASAT INTEND THAT THE ASIA-PACIFIC REGIONAL SYSTEM BE COMPLEMENTARY TO THE INTELSAT SYSTEM AND THAT IT BENEFIT ALL USERS IN THE ENTIRE REGION OF ASIA-PACIFIC, BY PROVIDING COST-EFFECTIVE RURAL AND INTER-ISLAND DOMESTIC AND INTERNATIONAL LINKS AS WELL AS LOW-COST EDUCATIONAL, CULTURAL, ENTERTAINMENT AND RELIGIOUS TV PROGRAM DISTRIBUTION, FOR THE BENEFIT OF ALL.

MANY COUNTRIES IN THE ASIA-PACIFIC REGION MAY AGREE WITH THE KINGDOM OF TONGA THAT A REGIONAL SATELLITE COMMUNICATIONS SYSTEM CAN PROVIDE SEVERAL KINDS OF SERVICES OF POTENTIALLY GREAT BENEFIT TO INDUSTRY, TRADE AND TOURISM OF THE REGION. IT IS OFTEN BENEFICIAL IN TELECOMMUNICATIONS TO HAVE AVAILABLE ALTERNATIVE FACILITIES, TO ASSURE COST-EFFECTIVE SERVICE ADVANTAGES AND TO OFFER USERS IN EACH COUNTRY A CHOICE OF TELECOMMUNICATIONS CARRIERS. IN OTHER WORDS, COMPETITION GENERALLY BENEFITS THE USERS OF COMMUNICATIONS SERVICES.

THERE ARE PRECEDENTS OF REGIONAL SATELLITE SYSTEMS ESTABLISHED OUTSIDE OF INTELSAT, MOST NOTABLY EUTELSAT, INTERSPUTNIK, ARABSAT, THE INDONESIAN PALAPA SYSTEM AND PANAMSAT. OTHERS ARE IN THE MAKING, SUCH AS ONE SYSTEM IN AFRICA AND VARIOUS ATLANTIC OCEAN REGIONAL SYSTEMS. OF COURSE, "COORDINATION" WITH INTELSAT CONCERNING ARTICLE XIV(D) "SIGNIFICANT ECONOMIC HARM" MAY AT SOME POINT BE NECESSARY BY COUNTRIES AND TERRITORIES OR JURISDICTIONS THAT BELONG TO INTELSAT. HOWEVER, SUCH COORDINATION WITH INTELSAT CAN TAKE PLACE LONG AFTER THE IOB IS FORMED AND NEED ONLY BE UNDERTAKEN IF THE TONGASAT REGIONAL SYSTEM EXCEEDS CERTAIN THRESHOLD LIMITS OF COMMUNICATIONS CAPACITY USED FOR INTERNATIONAL COMMUNICATIONS AND PUBLIC SWITCHED TELEPHONE NETWORK SERVICES, AS ADOPTED BY A RECENT INTELSAT ASSEMBLY OF PARTIES. IT IS POSSIBLE THAT THE ENTIRE FIRST GENERATION OF SATELLITES OF THE TONGASAT REGIONAL SYSTEM MAY OPERATE WITHIN THOSE THRESHOLD LIMITS, SO THAT INTELSAT COORDINATION IS NOT NECESSARY FOR A LONG TIME, MORE LIKELY NOT UNTIL THE LATE 1990'S.

WE WOULD BE GRATEFUL TO KNOW WHICH INSTANCES OF YOUR GOVERNMENT OR WHICH SEGMENTS OF YOUR PRIVATE SECTOR INDUSTRY AND FINANCIAL COMMUNITY AND COMMUNICATIONS USERS MAY WISH TO DISCUSS THIS INVITATION WITH US FURTHER.

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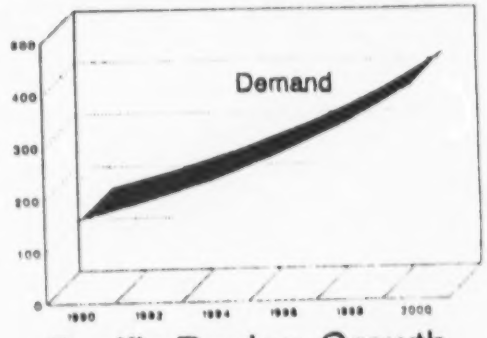
THANK YOU VERY MUCH FOR YOUR KIND ATTENTION!

TONGASAT'S VSAT SYSTEM

- REACHES DIRECTLY FROM ONE REMOTE VSAT TO ANOTHER (ON PALAPA MUST "HUB")
- C-BAND 1.8 METER DIAMETER
  Ku-BAND 1.2 METER VSAT DIRECT VOICE AND DATA
- CELLULAR SYSTEMS IN REMOTE AREAS OF ONE COUNTRY CAN INTERCONNECT DIRECTLY TO RURAL OR ISLAND TELEPHONE COMPANIES IN OTHER COUNTRIES
- TV RECEIVE DISHES 0.6 - 3 METER DEPENDING ON COVERAGE BEAM

• TRANSPONDER SALES • RENTALS



Pacific Region Growth

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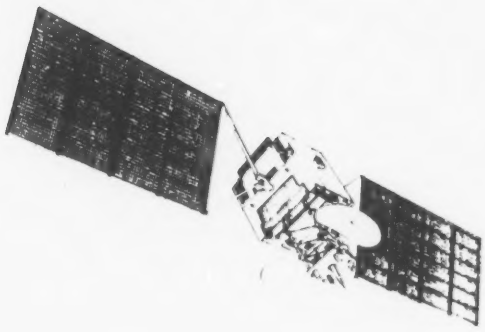
CONTACT NAMES AND ADDRESSES



WE INVITE YOUR COMMENTS.

FRIENDLY ISLANDS SATELLITE COMMUNICATIONS, LTD. (TONGASAT) IS A PRIVATE TONGAN COMPANY. IT IS THE EXCLUSIVE AGENT OF THE KINGDOM OF TONGA FOR DEALING WITH AND MAKING ARRANGEMENTS FOR ORGANIZATIONS TO LAUNCH INTO AND/OR OPERATE ONE OR MORE SATELLITES IN ORBITAL POSITIONS REGISTERED WITH THE IFRB ON BEHALF OF TONGA. AS SUCH, TONGASAT HAS REGISTERED ITS SATELLITE POSITIONS THROUGH THE GOVERNMENT OF THE KINGDOM OF TONGA.

PLEASE RECOMMEND TO INTERESTED USER GROUPS OR OTHER INTERESTED PARTIES AND COMMERCIAL ORGANIZATIONS IN YOUR COUNTRY TO CORRESPOND WITH ANY QUESTIONS TO TONGASAT:

DR. MATS C. NILSON, MANAGING DIRECTOR
TONGASAT

MANILA OFFICE FAX 63-2 817-6112
SAN DIEGO OFFICE FAX 1-619-270-4652
NUKU'ALOFA OFFICE FAX 676-22915

OR TO THE GOVERNMENT OF THE KINGDOM OF TONGA:

MR. SIONE KITE, DEPUTY CHIEF SECRETARY AND
DEPUTY SECRETARY TO CABINET
OFFICE OF THE PRIME MINISTER
NUKU'ALOFA, KINGDOM OF TONGA

FAX 676-23888

WE WOULD BE PLEASED TO HAVE YOUR RECOMMENDATIONS AND SUGGESTIONS IN WRITING.

YOUR CONTRIBUTIONS WILL ASSIST US IN DETERMINING WHICH SATELLITE ORBITAL POSITIONS ARE OF GREATEST INTEREST FOR THE INITIAL SATELLITE LAUNCHES TO BE RESPONSIVE TO DEMAND.

TONGASAT

An ISDN Multimedia Distance Learning Trial: Phase One Results Report

Professor Terry Curtis - California State University, Chico
Dr. Janet Davidson - Pacific Bell
Ms. Joyce Inkrott - AT&T Network Systems
Mr. John Perley - AT&T Network Systems

1. ABSTRACT

This is a report on a developmental test of a multimedia distance learning platform capable of supporting interactive video, voice, data, and graphics using BRI ISDN lines for transmission.

PROJECT OVERVIEW AND OBJECTIVE

The general objective of the Multimedia Distance Learning project was the development and assessment of an Integrated Services Digital Network (ISDN) Conferencing System as a potential solution to the national shortage of qualified science and math teachers.

The motive for action was based on the perceived decline in education services and resources in the United States. Noted education expert Arthur Melmed's February 1987 report to the National Science Foundation clearly identified the lack of capability and capacity as follows: "The current state of our schools is that there is a lack of adequate teacher personnel in exactly the areas where productivity must rise. Fewer than half of the teachers of precollege math and science are certified in all the subjects they teach. Of the 14,000 to 15,000 high schools in the U.S., 7,100 have no physics courses, 4,200 have no chemistry courses and 1,900 no biology. In addition, many courses lack fundamental rigor because of inadequate teacher capability."

Recognizing the need for improvement in education delivery, Pacific Bell and AT&T are partnering with California State University in Chico, a national leader in satellite and microwave distance learning technologies, to assess the use of ISDN networks for teaching.

A premise shared by the project sponsors was that an ISDN distance learning network would be more cost-effective than private leased line facilities or satellite, and would also provide sufficient bandwidth to support the use of voice, data, video and graphics for improved interaction between teachers and students. This premise was also supported by a number of industry experts who predicted that the integration of the telephone, TV, and computer could potentially revolutionize traditional approaches to education and entertainment.

Since theories need to be supported by facts before business decisions can be made, Pacific Bell, AT&T Network Systems and California State University Chico agreed to jointly assess the feasibility of the concept. A number of project hurdles such as system design, instruction module development, team participation, etc. needed to be crossed in order to proceed. Recognizing the complexity of the tasks, a three phase project plan was conceived. Each phase was designed to progress in functionality from point to point voice, data and video conferencing to fully interactive multimedia multipoint distance learning.

This report documents the findings of Phase One as a foundation for future phases. It is assumed that additional objectives will be identified and addressed by the respective teams upon review of this report.

PHASE ONE DESCRIPTION

Phase One focused on the development and test of a single site delivery of a multimedia class in Physics. Equipment (hardware and software) was installed prior to conducting the class modules in order to minimize the "Hawthorne Effect". The classes were delivered in May 1991, and recorded in VHS videotape for evaluation and review.

Fairview High School, a continuation school in Chico for returning students, was selected as the initial test site. The team members felt that Fairview provided an extremely demanding test environment because it's demographics represent a mix of at risk, economically, socially and academically disenfranchised students. Mr. Van Veen, the science teacher at Fairview, also has a reputation for education innovation and is an active member of the California State Education

Department's Mathematics Curriculum Committee. The team believed that the successful testing of the ISDN BRI model with this particular population would demonstrate ease of use for all learners.

The overall goals of the project were quite ambitious. Early meetings with the project team indicated that an ideal distance learning environment would be technically possible but economically prohibitive. A set of ideas and concerns were derived from interviews with four experienced instructors. The interviewees were: Dr. Joseph Lipson, Dr. Terry Curtis, Dr. John Ittelson and Mr. John Van Veen. A summary of their perspectives follows.

- Instructors want real-time full-duplex audio to support classroom interaction.
- Minimal equipment should be required at a remote site in light of the limited financial resources, and because fewer devices would mean easier setup, operation, security, and maintenance.
- The need for two way interactive video was not seen as a key initial concern. This subject will be explored during the trial.
- Instructors want a database of modern visual aids to supplement their lectures, e.g. videodisc access.

The **OVERALL PROJECT TEAM** was chaired by Dr. Terry Curtis. Also, in response to the intricacy of the project, three teams were created along task lines in order to ensure maximum objective coverage. A description of these teams follows:

The **INSTRUCTIONAL DESIGN TEAM** was charged with developing a physical science class module which would rely heavily on visual reinforcement, and required a "MASTER TEACHER". Team members were Dr. Joseph Lipson, Mr. John Van Veen, Dr. John Ittelson and his students.

The **TECHNOLOGY PLATFORM TEAM** concentrated on the development of a multitasking multimedia platform that would allow access to an ISDN equipped central office and support the effective transmission of multimedia PC based instructional modules. Team members were Ms. Joyce Inkrott, Mr. John Mitchell, Mr. Tom Leslie, Mr. Charles Eyster, Dr. John Ittelson and a number of his students.

The **EVALUATION AND DOCUMENTATION TEAM** had the charter of providing objective information that would assist decision makers during the progressive stages of the project program development and implementation. The members of this team are Dr. Janet Davidson and Mr. John Perley. Dr. Robert Main and his support team at CSUC plan to issue an independent evaluation of the learning impact of the technology. Dr. Main's assessment will provide "empirical evidence of the learning outcomes and documentation of the instructional methods, delivery techniques and system requirements to assist educators, curriculum developers and instructional technologists in making decisions on the adoption of similar learning projects".

PHASE ONE TEST RESULTS

Four one-hour classes were taught, using the ISDN network and platform, on May 21, 23, 28 and 30th. The head end, or teacher workstation, was located at the CSUC library and operated by Mr. Van Veen. The remote end, or student workstation, was set up in Mr. Van Veen's class room at Fairview High School. The class sessions included teacher lecture, real-time interactive two way audio and video communication, laserdisc video clip display, image transfer and screen annotation, all controlled from the teacher workstation. Students were also able to annotate and send graphics, images or text.

Pre-class interviews were conducted with the team members in order to get a sense of concern and personal desires regarding the exercise. Post-class interviews were conducted to evaluate actual versus expected results.

Mr. Van Veen's pre-class impressions included: A great amount of pre-class "free floating anxiety" because this was the first lesson in an unknown environment. The preparation of the class session would lead to a "superior lesson" because previously unavailable media resources are now available.

Mr. Van Veen's post class impressions included: "TERRIFIC CLASS". The students were super and they contributed to the success of the session.

Familiarity with the equipment led to successful class delivery. Volume of available material exceeded student capacity and needs to be adjusted in subsequent classes. Interaction was excellent. Mr. Van Veen commented that "before today's class I did not see a real need for two way video. Today I do." The system as it stands now is great. Some additional enhancements such as private conferencing, a wider field of view and slide/visual out of sequence selection would be helpful. Concerns about keystroke patterns and the potential for disrupting a class session by inadvertent keystrokes indicated that a click and select icon command would be more user friendly.

The post class interview with the students indicated that they felt the class was successful. Mr. Van Veen's teaching style contributed to the success. They felt that they got as much out of the delivered course as if Mr. Van Veen was physically present in the classroom. The recording of the experiment and the presence of the project observation team was not disruptive. They felt that Mr. Van Veen conducted the class well and they did not see the need for an on-site instructor.

On the whole, the project team was pleased with the outcomes of the Phase One experiment as a precursor for the following phase.

CONCLUSION AND COMMENT

This report covers interim results of a project in process of completion. The conclusions presented here must be considered preliminary and are subject to change as the project progresses.

Given that the objective of Phase One was to provide the project team with a determination of design factors and base requirements for subsequent phases, the experiment has been a success. The evaluation of the effectiveness from the student and teacher perspective is that the remote module delivery is as effective as an on site delivery method. From that viewpoint, the team is encouraged to test the simultaneous delivery to multiple class sites.

Please note that the Phase One student population is classified as an "at risk" universe. Therefore we believe that their impressions are not directly transferable to a "mainstream" mass market environment. The indication from instructors familiar with the Phase One students' normal class activities indicated that normal attention to instruction was experienced throughout the experimental classes.

A key design question for the technology team was whether the difference in the quality of real-time video at 64 KBPS or 128 KBPS would be apparent to the students. The video tape record indicates, by lack of comment, that the variation in bandwidth was transparent to the class participants.

Our review of the class sessions and commentary suggests that the following items be addressed in future phases:

- The mechanisms and procedures for the video tape recording of the class sessions and other project activities needs to be strengthened. A number of Phase One video records were unusable because of poor audio quality. In addition, fixed angle shots of the classroom did not allow for a review of participants' physical reactions (body language) to the delivery method and course materials.

- The need for a wider field of view from the teacher workstation was voiced by Mr. Van Veen.

- The ability for remote camera panning of the class site would enhance the instructor's ability to monitor the class activities. Remote panning will also minimize the need for students to parade their work before the classroom cameras.

- Easier access to locally stored multimedia materials on an ad hoc basis. Mr. Van Veen's request for icon control, rather than function key control, is being addressed.

- Improvement in the audio quality and associated mechanisms

- Student and Teacher operational training procedures need to be improved. A review of the tapes showed that the participants, both teacher and students, had occasional difficulty with the operation of the equipment. Some thought should be given to the development of equipment operation training as well as the design of a more friendly user interface.

- Automation of the "Private Conference Feature" would allow the instructor to conduct a private conference with a student without disrupting the class flow.

- The impact of end user interface when the experiment is conducted among multiple parties needs to be assessed. This assessment could be conducted within the context of a proposed Pacific Bell/AT&T Network Systems Joint Market Research project.

- Regarding the evaluation of effectiveness, we feel that the control measures included in Phase One were adequate for the stated purpose of Phase One. However, in line with Dr. Main's Evaluation Plan and the CSUC Distance Learning Grant Application, conscientious adherence to the proposed measurement methodology is essential if inferences are to be made regarding the impact of this technology on learning.

- Students enjoyed the use of laserdisc video and animated graphics. These elements contributed to the acceptance of the class. The preparation of class modules which incorporate laserdisc videos and pre-class prepared graphics requires a substantial amount of effort on the part of the instructor. We recommend that future phases include the testing of technology without these elements. The conducting of a class with only ad hoc elements such as a scanner, electronic tablet, interactive voice and video, and screen sharing will indicate the utility of the system for those classes which are not enhanced by laser disc video or animated graphics.

- Future measure of effectiveness should include comparisons with a control class as a benchmark. This would provide for a qualitative comparison of learning outcomes from different instructional approaches. An evaluation of the effectiveness of the multimedia method is a key element for encouraging future development efforts.

- Fairview High School provided an acceptable test site. However, if this teaching approach is to be evaluated for the mass education market, the inclusion of traditional high schools in later phases is required. The incorporation of additional schools with larger class populations and different instructors would provide the Evaluation Team with a means of assessing the effectiveness and utility of the multimedia distance learning application as a mass market offering.

In conclusion, the following findings from Phase One are key elements in planning future phases:

- The technology worked according to expectation.

- The point to point ISDN connectivity performed as required.

- The teacher interface performed adequately.

- The students accepted the concept and performed at normal levels without the in-room presence of a qualified science teacher.

DISTANCE LEARNING SYSTEM USING ISDN

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ABSTRACT

This paper describes a field trial in distance learning using ISDN public network in Singapore. Computer-Based Training (CBT) is adopted as the delivery system as it can be efficiently administered at low cost. The CBT system adopted will be able to develop and deliver courseware in English, Spanish, Japanese and Chinese. Fujitsu Limited/Japan and Fujitsu (Singapore) Private Limited conducted an experimentation in Singapore using IBM PC compatible (with EGA/VGA) and the FETEX-150 digital switching system. A collaboration programme between Fujitsu/ Singapore and the Ngee Ann Polytechnic of Singapore was launched in 1991 to develop and implement a full scale ISDN distance learning system for the campus by 1993. The joint development project could also be applied throughout the Asia Pacific region and many other regions in the future.

INTRODUCTION

The Singapore Telecom has introduced ISDN public network in the country. Many sectors of industry are encouraged to explore the application of ISDN. In the education industry, the transfer of instructional materials with voices over distances is the target of development. The idea of ISDN distance learning is thus formalized **[*1]**.

The exploitation of the computer technology and telecommunication know-how results in the emergence of ISDN distance learning as a new challenge to facilitate self-paced learning without the constraints of space, time and instructor. It falls in line with the recent announcement by the Singapore Government to implement distance learning as an avenue for working adults to pursue higher education at home in the evening.

The Ngee Ann Polytechnic of Singapore has, since 1980, placed an importance in the development of computer education to improve the quality of learning and teaching. CBT has been adopted as a delivery system to assist the students who are weak in their studies **[*2]**. In addition, CBT allows students to gain access for an on-line self assessment to determine their level of achievement. These CBT activities form a good platform for distance learning.

Fujitsu which emphasizes on a full exploration of the latest technology for educational use conducted an experimentation to adopt CBT as a delivery system for distance learning using the ISDN public network. The success of the proto-type system leads to the collaboration with Ngee Ann Polytechnic to further research and develop a full scale ISDN distance learning environment. It is believed that the joint project is the first in the Asia Pacific region.

PRESENT SITUATION AND PROBLEM WITH DISTANCE LEARNING

The concept of distance learning is not new. However, efficient mode of delivering information and instructional materials is the main concern. Intense competition for the best possible delivery of information in the shortest time is the norm of today. There is the crucial need to obtain information fast without the constraints of time and location. Conventional distance learning systems can be classified into text-based CAI delivery system with personal computers connected to low-speed public telephone lines via modem. There is also the remote classroom system in which training is administered over satellite TV conference system. Although modem hooking are economical, text-based materials tend to be dull and less interactive. On the other hand, the training delivered through TV conferencing is interesting and highly interactive but the running cost is high.

An alternative solution is sought. Fujitsu/Japan and Fujitsu/Singapore set up a proto-type system to illustrate the use of ISDN public network in Singapore as a means to provide CBT courseware delivery at a low cost. Details of the field trials are reported in the following sections.

ISDN DISTANCE LEARNING FIELD TRIAL

The field trial requires the production of a graphic-intense CBT courseware to be delivered through ISDN public lines at a high speed. The courseware was produced on SchoolBox II which is an integrated authoring system developed by Fujitsu International Engineering Ltd, Japan. The hardware used in the experimentation comprise of IBM PC compatible (with EGA/VGA) and Fujitsu's FETEX-150 digital switching system. The transfer of courseware was on the ISDN B-channel (64 kbps, circuit switched) using a low cost ISDN-PC board which is plugged into the computer. The ISDN-PC board is developed by Singapore Telecom and ITI, a subsidiary company of the Singapore National Computer Board.

The experimentation was satisfactory and considered as sound. Some features of the distance learning system includes :-

a) Educationally sound courseware with appealing colour graphics are offered to anyone at anytime in anywhere. At 64 kbps, a 30 minute learning module can be downloaded in less than 2 minutes. The ISDN line is then immediately disconnected once the module is downloaded. While the module is downloading, an overview is displayed on the screen so that the learners need little waiting time; and

b) Learning records are collected in real time. Records are quickly analyzed so that learners are kept informed instantaneously. The learner information is also put on a database so that individual training problem and the learner's performance can be both addressed. Using the other B-channel, oral instruction can be offered while the learner is viewing his/her lessons on the screen.

It was convinced from the experimentation that the implementation of distance learning system over ISDN network would be able to provide high personalized coaching on non-programmed information to the learners. This is illustrated in Figure 1.

FUJITSU - NGEE ANN POLYTECHNIC COLLABORATION PROGRAMME

With the success of the proto-typing system, Fujitsu prepares to work with academic institution to develop and implement a full scale ISDN distance learning. Fujitsu and Ngee Ann Polytechnic (NP) had an earlier partnership in the development of a CBT Courseware Development Methodology and generic graphics library using Fujitsu's integrated authoring system, the SchoolBox II. The joint project has given the confidence and provided the platform for the two organizations to launch a second collaboration programme on distance learning.

Fujitsu and NP signed a Memorandum of Understanding in 1991 to jointly work on the realization of a full scale development and implementation of ISDN distance learning over the next two years. SchoolBox II will be adopted as the authoring system for CBT courseware delivery. NP builds a common database of courseware and graphics screen library to prepare for the distance learning. Fujitsu assists NP in the technical area of telecommunication.

The scenario of implementing ISDN distance learning are as follows :-

(a) Students residing in or outside the campus retrieve information and instructional materials for learning and upload completed assignments back to the host computer in NP. Students belong to the same working group interact with their tutors at the same time through voice conferencing;

(b) Working adults and NP graduates register for modular courses to further enhance their study at home; and

(c) CBT courseware will be delivered in multiple languages, viz English, Spanish, Japanese and Chinese.

The rationales behind the development of distance learning in NP are based on : -

(a) a large enrolment of 12,700 full time student;
(b) the philosophy of keeping abreast with changing technologies;
(c) more that 40% of NP students own a PC at home;
(d) PC loan/rental scheme to assist students to own a PC; and
(e) many faculties are interested to product CBT courseware.
(f) validation of the effectiveness of CBT as a consistent and efficient delivery system **[*3].**

The ISDN distance learning plans are depicted in Figures 2a - 2b. The plans are to develop a decentralized distance learning environment in which each academic department has its own host computer to serve the students registered under the department, update relevant learner's performance and history record.

Fujitsu and NP development team has begun to research, develop and implement ISDN distance learning system to serve many clusters of students. Each cluster of 25 students will access a course module at the same time. The development schedule over the next two years is shown in Figure 3.

EFFECTS AND IMPLICATION ON THE EDUCATIONAL PROCESS

Education is a vital component of the human development. It is imperative to place a high premium on education to ensure the fullest development of the generation. The investment in distance learning using ISDN public network meets the educational aims of nurturing inquiring minds and developing individual potential to the fullest. Distance learning without the constraints of time, space and teacher provides great opportunities for one to upgrade the skills, broaden knowledge, interact with each other and communicate effectively.

ISDN distance learning has a definite impact on the existing educational process. It is a good means to supplement the traditional instructor-led classroom learning and teaching process **[*4]**. It also serves the aspiration of working adults who wish to enhance their educational level but are unable to follow the conventional full time educational system.

The conventional modes of distance learning are giving ways for the more productive but low cost mode of CBT courseware delivery using ISDN public network. The anticipated lower charges in ISDN line in the near future is an added value to the distance learning development.

In Singapore, the government-led drive to exploit the use of information technology has given a push for the education industry to review, revise and improve upon the educational processes to bring the best in each learner. ISDN distance learning is information technology in education and its widespread application and adoption are anticipated.

The development of ISDN distance learning in Ngee Ann Polytechnic becomes a model of new educational technology. To achieve a wider application of distance learning, the development procedure should be shared among academic institutions and industries involving in training not only in the country but also in many other regions.

CONCLUSION

The realization of ISDN distance learning is a combined effort of Fujitsu and Ngee Ann Polytechnic. It is a manifestation of industrial and academic collaboration **[*5]** to explore and exploit the latest technology for educational use and the benefits of mankind.

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ACKNOWLEDGEMENT

1. **FETEX-150 and SchoolBox II are registered trademarks of Fujitsu Limited.**

2. **IBM PC is registered trademark of International Business Machines Corp.**

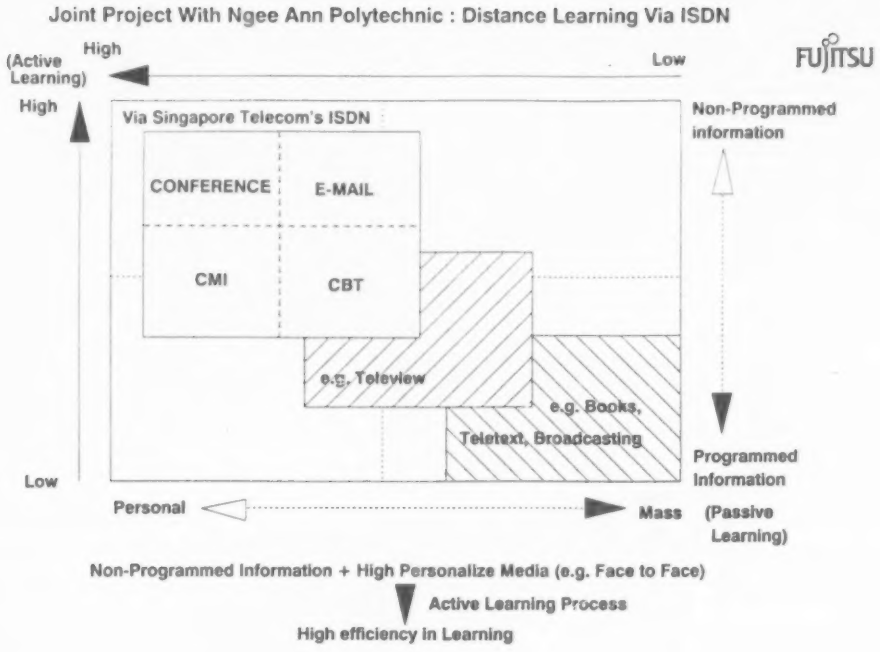
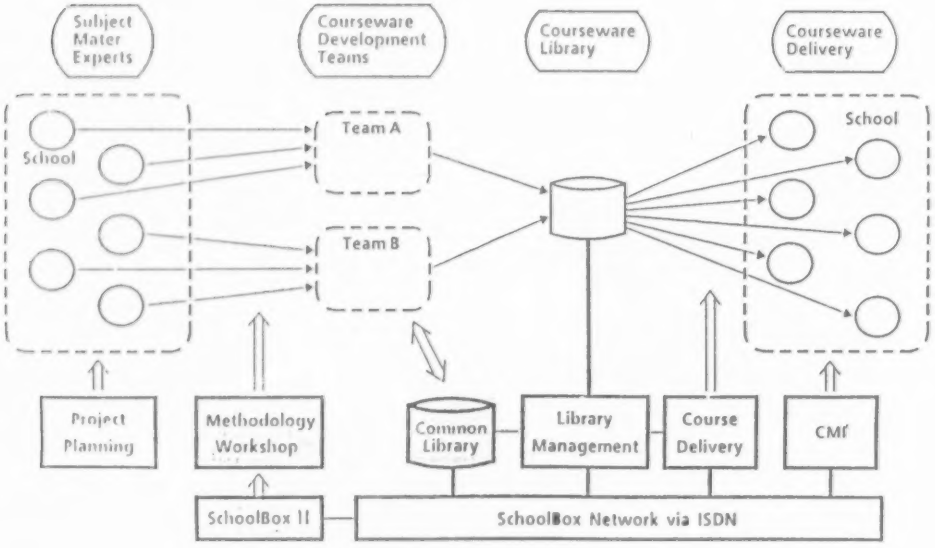


FIGURE 1 ISDN DISTANCE LEARNING ON PERSONALIZED COACHING



DISTANT LEARNING CONCEPT

FIGURE 2a ISDN DISTANCE LEARNING PLAN

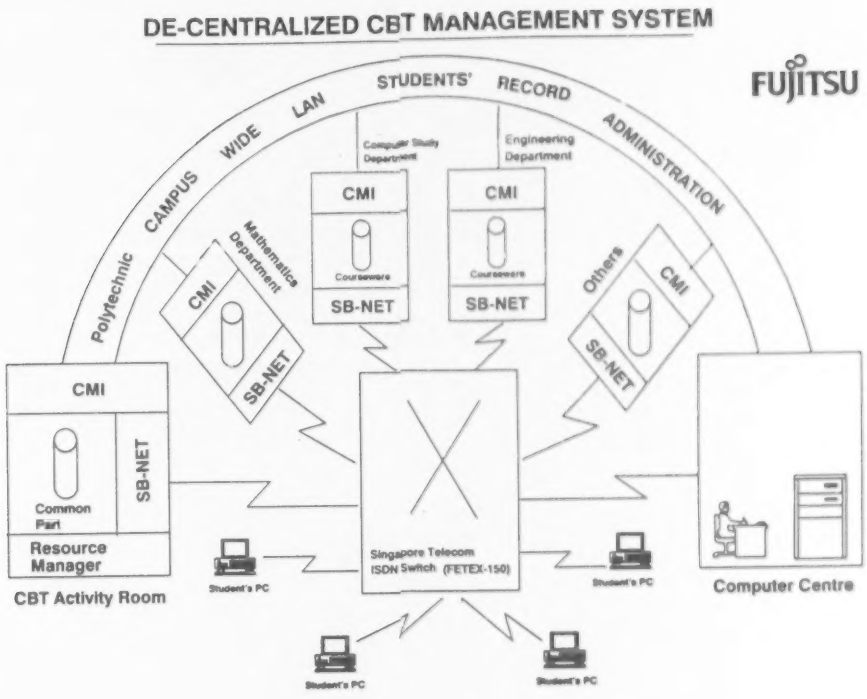


FIGURE 2b ISDN DISTANCE LEARNING PLAN

FIGURE 3

SCHEDULE FOR JOINT DEVELOPMENT ON DISTANCE LEARNING VIA ISDN

FUJITSU

May 1990 – July 1991: Preparation Phase

1. First MOU
   a. CBT Courseware Development Methodology
   b. Generic Graphic Library Building
   c. Distance Learning Proto-Type System Development

September 1991 – December 1992: Field Trial Evaluation

2. Second MOU Signing
   a. Joint Unit Test Components (10 sites in Polytechnic, 2 sites in Schools)
      . Distance Learning Communication Test
      . Computer Managed Instruction (CMI) Test
      . Courseware Development & Testing
        (20 to 30 hours of courseware & Questionaire Database)

January 1993 – December 1993: Implementation

3. Joint System Test
   a. Fujitsu provides communication software system
   b. Ngee Ann Polytechnic provides courseware, CMI data for total integration test.

An Electronic Mail Network Linking Libraries in Remote Micronesian Islands

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1. ABSTRACT

This paper describes an experiment to facilitate electronic communication capabilities among libraries and archives on remote islands in Micronesia in an effort to establish a regional library and information resource sharing network. It also reviews the implementation problems encountered and the benefits derived from this experimental remote electronic mailbox network.

2. INTRODUCTION

Traditionally, in many developed countries, libraries and archives were established to collect and house materials capable of meeting the information needs of their users. With the worldwide information explosion now occurring, individual libraries can no longer collect all the resources necessary to consider themselves self-sufficient. To remedy this, elaborate networks to share information resources have been established throughout the world.

In contrast, libraries and archives in most parts of Micronesia are just beginning to be established, most collections that do exist are severely limited and there are no resource sharing networks in place within the region. Moreover, until the creation and first meeting of the Pacific Association of Libraries and Archives (PIALA) in 1991, there was no formal regional association to even address the issues of developing regional cooperative efforts for resource sharing (1).

The challenge of collecting and sharing information resources in Micronesia is further exacerbated by the remoteness and isolation of the individual islands. Yet, if this region is to continue developing educationally, economically and politically, the establishment of cooperative networks for the sharing of library materials and information resources is critical. The authors feel the key to establishing and maintaining a regional cooperative network for resource sharing is to develop an inexpensive, reliable and effective electronic communication network through an existing appropriate technology analog network.

3. BACKGROUND

Electronic telecommunication among libraries for resource sharing has been effectively utilized throughout the developed world. The literature on this subject cites examples of libraries using electronic mail systems for interlibrary loan of materials as early as 1982 (2). The need for this capability within Micronesia was the basis of the experimental project described in this paper.

In 1991, the Office of Territorial and International Affairs of the United States Department of the Interior funded a project to purchase, install and demonstrate an electronic mail system linking four sites in Micronesia to facilitate interlibrary resource sharing. This experimental system links together the R.F. Kennedy Memorial Library of the University of Guam, and the Palau Division of Archives, the Micronesian Occupational College and the Palau Public Library in Koror, Palau.

This electronic communications link was demonstrated in the Fall of 1991 at the first regional meeting of PIALA held in Koror, Palau. The communications link is based on a specialized modem/electronic mail package designed by Mallard Concepts, Ltd., London, England. The package was originally funded by UNESCO and designed for remote computer networking in Africa and other digitally deprived developing areas. In this

paper, this modem/electronic mail package will be referred to as the Mallard mailbox (3).

In the recent past, commercial voice and facsimile (FAX) transmission capabilities within Micronesia did not exist; or if they did, they were too costly and/or not reliable enough to allow for the development of dependable communication networks. In the early 80's, MICRONET, a subset of the PEACESAT network, began experimenting with computer/voice-integrated networking incorporating modified APPLE 300 baud modems through the PEACESAT ATS-1 satellite. More recently, MICRONET is experimenting with packet terminal node controllers at some of its sites over high frequency (HF) and very high frequency (VHF) radio links.

Now, with the reestablishment of the PEACESAT network utilizing a relocated GOES satellite and the associated earth stations located throughout Micronesia, there is the potential to provide cost effective and reliable message transfer systems. In the experiment described, the newly established PEACESAT nodes provide the conduit for electronic networking among libraries and archives.

4. IMPLEMENTATION

In general, the Mallard mailbox can network remote local libraries and archives into the district or state educational PEACESAT earth station either through the local island telephone loop; or, if applicable and with some hardware modifications, using simplex VHF or HF radio. The messages are then uplinked and received by other similarly linked Pacific Island libraries and archives.

The current Palau intra-island network topology has Mallard mailboxes in the local library and archive offices connected to the local island telephone loop. These on-island sites can leave or pickup messages to or from any other on-island Mallard mailboxes. With this technology, a computer need not be dedicated; the Mallard mailbox only needs to be connected to a phone line to receive or store messages. Periodically, users check the front panel *message-received* indicating lights to determine if there are any received incoming messages.

To facilitate the inter-island networking between distant sites in Palau and the University of Guam, the Mallard mailboxes have been directly connected over the PEACESAT network link. To date, however, the results have been less then reliable. Experimental attenuators have been installed and system levels will be optimized for Mallard mailbox to Mallard mailbox inter-island networking.

At this point, the authors of this paper hope to work directly with the Mallard mailbox designer, Martin Allard, at this PTC' 92 conference.

Currently, the Palau and University of Guam PEACESAT earth stations have Mallard mailboxes on-line to pick up local messages which are then captured and passed over the PEACESAT Telebit T2500L built-in modem at the earth station.

As noted, this experiment was designed to directly or indirectly link remote Micronesian libraries and archives through their local PEACESAT network nodes. However, another data transfer network configuration, known as the star hub topology, is currently being used with the Mallard mailboxes in this project while development work is being done to implement the original design.

The star hub topology works by having remote Mallard mailboxes pass a message to the local PEACESAT earth station's Mallard mailbox. The local earth station operator then transfers data from the earth station's Mallard mailbox on to the Telebit modem which connects and passes the message to the Honolulu PEACESAT hub. The message is then picked up by the destination island's PEACESAT earth station's Telebit modem where it is then operator downloaded to the earth station's Mallard mailbox and finally passed on to the end user's local Mallard mailbox. This provides "BBS" style (store and forward) messaging service to Honolulu and other interested PEACESAT nodes.

5. BENEFITS

The Mallard mailboxes provide for a low-cost private electronic mail network without the need of a dedicated on-line CPU, except when uploading or downloading messages. Any MS-DOS or MacIntosh CPU can upload messages to or download messages from the local Mallard mailboxes.

The system is quick to learn and easy to use, as was shown during the PIALA meeting demonstration referred to previously in this paper. Librarians and archivists attending the demonstration were able to send and receive messages within a few minutes of viewing the demonstration.

The authors of this paper have had excellent communication with the designer of the Mallard mailbox. This is a critical factor when experimenting with new technology in remote areas.

6. FUTURE DIRECTIONS

The Mallard mailboxes installed and demonstrated for this project have become

a permanent electronic link between the four sites. By adding additional Mallard mailboxes, this working system can be expanded to link other libraries and archives in Micronesia and to serve as the foundation for the development of a regional remote electronic communications network, in conjunction with the PEACESAT network.

Reestablishing the PEACESAT network also provides for the regional development and expansion of distance education offerings throughout the Western Pacific (4). The success of distance education course offerings is in no small way dependent on access to information and library resources. This was recognized by the Agricultural Development in the American Pacific (ADAP) Distance Education Consortium; a Library Resources Consultant was included in the membership of the Consortium from its inception (5). Much of the work of this consultant will be in establishing communications capabilities among providers and receivers of distance education courses to meet their library and information needs. The development of the regional library electronic communications network is essential in providing for ADAP's needs.

At present, the PEACESAT earth stations are routinely passing FAX, lumaphone (picture) and data via the Mallard mailboxes and Telebit modems. The authors of this paper will continue to experiment with direct modem to modem connects via the Mallard mailboxes. Work will also continue with the Mallard mailbox designer to develop a standard modem mode to allow networking with other modems and local area networks.

Hopefully, our pioneering efforts will allow for the expansion of the library electronic communications network and will subsequently be used to create other private electronic communications networks throughout the islands covered by the footprint of the PEACESAT-GOES satellite.

FOOTNOTES

1. The 1991 Pacific Association of Libraries and Archives Conference, "PIALA 91" held in Koror, Palau, October 1-3, 1991.

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4. Boughton, G., Bruce Best, et. al, "Distance Education in the Western Pacific: Accomplishments and Future Trends," in Dan J. Wedemeyer and Mark D. Lofstrom (eds.), *PTC '91 Proceedings* (Honolulu, Hawaii: Pacific Telecommunications Council, 1991), pp. 235-239.

5. The initial organizational meeting of the ADAP Distance Education Consortium was convened at the University of Hawaii, Honolulu, Hawaii, July 29-30, 1991. The ADAP Distance Education Consortium is part of the ADAP Project which is a consortium consisting of the Land Grant Programs at the following post secondary institutions: the Community College of Micronesia, the Northern Marianas College, the American Samoa Community College, the University of Guam and the University of Hawaii. ADAP is funded annually by the United States Congress and is administered by the United States Department of Agriculture, Cooperative Extension Service.

Distance Research: Library Research Without Going to the Library

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1. ABSTRACT

Appropriate access to research materials has long been dearly missed not only as an essential component of distance education, but by all students and scholars without a research library across the street. In recent years, libraries have begun more and more to take advantage of developments in telecommunications and electronic information storage and retrieval, and it is increasingly more possible to do library research and to obtain library materials without ever having to step into a library building. This paper discusses CD-ROM databases, library online public access catalogs (OPACs) and databases on OPACs, online databases and resources on the Internet.

2. INTRODUCTION

Imagine: library catalogs, journal indexes, full-text document delivery, including graphs, charts and illustrations, the multi-object desktop with text, pictures, sound and video -- all available to you in your office, at home, anywhere -- instantly. This is the kind of scenario that makes the heart beat faster in every information society enthusiast and in many a university scholar.

"All information in all places at all times," proclaim Godfrey and Parkhill in their book Gutenberg Two, and continue, "The impossible ideal. But the marriage of computers with existing communications-links will take us far closer to that goal than we have ever been." (1)

Whether we even want to be there or not is an entirely different matter, but undoubtedly many components of the often envisioned "scholar's workstation" are already in place, and others are being developed at a dazzling rate.

Conducting research, simply put, is a two-step process that entails a) identifying appropriate information and b) ownership of that information. The materials, to simplify again, come in basically two formats, either books or journal articles, which are either printed on paper or stored electronically. The different technological options for identifying research material and for document delivery (discussed below) each lend themselves to different parts of the research process.

3. CD-ROM DATABASES

CD-ROM (Compact Disc-Read Only Memory) technology was developed in late 1984 as an offshoot of the audio compact disc. Since then CD-ROM as a medium for data storage and retrieval has evolved at a rapid pace. In 1986 there were only 48 titles available in this format. By mid-1991, this number had skyrocketed to 1,960 titles (2), and by the end of 1991 there will have been an estimated 2,400 titles.

Especially libraries have eagerly embraced this new technology. A recent survey of all ARL (Association of Research Libraries) member libraries (3) found that 96 percent of them now offer reference use of CD-ROM databases. For the first time, a large number of students and researchers are enjoying the convenience (speed, economy and versatility) of electronic information retrieval because none of the surveyed libraries charge for CD-ROM services. Nearly 38 percent of the libraries have installed CD-ROM LANs (Local Area Networks) -- a technology considered impossible just a few years ago -- to provide access to their frequently more than 30 databases.

An even more recent technological development is the possibility of dial-up or remote access to CD-ROM LANs. According to the survey cited above, only five research libraries besides the University of Hawaii's Hamilton Library currently offer this capability. It is this aspect, of course, which is most attractive in the context of distance research. The University of Hawaii at Manoa has installed three CD-ROM LANs: in Sinclair Library, in the Science and Technology Reference Department of Hamilton Library, and the largest in Hamilton Library's General/Social Sciences and Humanities Reference Department, with 11

different networked databases for journal literature indexes in business, sociology, public affairs, education, and psychology, as well as for indexes to major national newspapers.

Remote access is presently available to the latter from two dedicated nodes on the dial-up module of the LAN for the UH-Hilo library and for the Maui Community College library. The connection is made from the Gandalf Starmaster in Hamilton Library to the UH Computing Center Starmaster and then via a T1 line to the local Starmaster portside in Hilo and on Maui. Two additional nodes are planned for Kona and Kauai. The possibility of providing access to the CD-ROM LAN at Hamilton Library through the UH telecommunication and computing network is also being explored for the future. This would potentially allow remote access for the entire community and for anyone with access to the UH network.

Although most bibliographic CD-ROM databases so far provide only indexing and abstracting to journal literature, there is a definite trend toward full-text, thus enabling users to obtain complete documents. One case in point is UMI's Business Periodicals Ondisc, which holds 240 CD-ROMs in a jukebox configuration. The system contains the full-text of some 400 business journals. A similar full-text project is underway at Information Access Company, with another involving a joint venture between UMI and H. W. Wilson for the social sciences.

4. ONLINE DATABASES

Access (via microcomputer, modem and phone line) to electronic databases loaded at remote host sites of databases vendors has been available since the mid-1970s. The number of individual databases has increased continuously. Just during the past ten years it has gone up from about 600 in 1981 to more than 5,000 in 1991 (4). Until the mid-1980s and the advent of CD-ROMs, online databases were the only option for electronic information retrieval in academic libraries. However, although nearly all research libraries provide access to often several database vendor services, cost has de facto limited their use to faculty, Ph.D. and M.A. candidates -- unless online searches were subsidized by the library.

All of the major vendors charge for online searches according to the pay-as-you-go principle (beyond a subscription fee or a monthly minimum). The cost incurred is a combination of telecommunications charges (ca. $12 per hour), connect time charges for a particular database on the vendor's mainframe (from $35 to $300 per hour) and print or display charges for individual records (15 cents to $120 per item). Most online databases are either numeric, bibliographic or of a directory type and, paralleling a trend in the CD-ROM industry, producers are increasingly offering full-text databases. The following paragraphs briefly highlight some of the major database vendors. For information on other databases and database vendors consult the online directory listed in the Appendix.

4.1 DIALOG INFORMATION SERVICES

DIALOG offers more than 1.3 terrabytes of data in more than 400 different databases covering all subject areas of knowledge. More than 1,700 full-text sources and journal files are available on the system. The initial subscription fee is $45 ($35 from the second year onward) and DIALOG offers a special subscription package called Knowledge Index for 100 of its databases at a fixed fee of $24 per hour. For further information call 1-800-334-2564.

4.2 DATA-STAR

Data-Star, a European-based database vendor, is quick to point out to U.S. customers that the location of their mainframe in Berne, Switzerland, doesn't mean a delay when connecting via SprintNet and underground/sea cable. They have more than 250 databases in all subject areas but are obviously particularly strong in European databases. Data-Star offers a $20 per hour "after dark" discount, which for Hawaii is in effect practically all day long. There is no initial sign-up or annual fee. For further information call 1-800-221-7754.

4.3 BRS

BRS's subscription cost varies depending on the package -- between $75 and $95. At this point, only about 20 percent of its 150 databases are full-text. The coverage is for all subject areas, but is particularly strong in the medical and pharmaceutical fields. For more information call

1-800-289-4277.

4.4 LEXIS/NEXIS

LEXIS/NEXIS, international in scope, is a specialized online vendor for legal, business, news and governmental databases. It offers the full-text of more than 800 journals and other publications including many news wires, SEC filings, the CFR, the full-text of bills, and the Federal Register. The annual subscription is $125. For more information, call 1-800-227-4908.

4.5 STN INTERNATIONAL

STN, the scientific and technical information network, is an online system providing access to more than 100 bibliographic, numeric, structural and full-text databases in all areas of technology and the sciences. The one-time start-up fee is $25. For more information, call 1-800-848-6533.

5. ONLINE PUBLIC ACCESS CATALOGS (OPACs)

Online catalogs are common in libraries. In the survey mentioned above, we found that 98% of all ARL libraries now have an electronic catalog to their library holdings and nearly all of them offer dial-up access. In the last couple of years, however, a new trend has set in and libraries are beginning to load other databases on to their systems. This is also the case at the University of Hawaii.

With the beginning of this year, UH switched over to the CARL system (originally developed by the Colorado Alliance of Research Libraries), mainly because it has that capability. Some of the databases on the system available now include: the Hawaii State Data Book (full-text), the Hawaii Sheet Music Index, the Trust Territory of the Pacific Database, Federal Government Documents Publications (index), and UnCover (an index to over 10,000 journal titles in all subject areas, with coverage beginning with Oct. 1988). UnCover distinguishes itself for two reasons, a) the indexing is extremely current by any standard and b) it allows the user to order the full-text of an article identified in the index, pay for it with a credit card and have it faxed within 24 hours to any fax machine.

ERIC, one of the most heavily used electronic databases, covering all aspects of educational journal literature, will soon also be available on CARL. Loading other commercial databases is being discussed.

The CARL system can also function as a gateway and thus allows access to other local information systems, like ACCESS (the Legislative Information System), Hawaii FYI, and the Hawaii State Library system and to other mainland library systems.

Remote access capability to UH CARL for the Pacific region is also (in addition to the INTERNET discussed below) provided via PEACESAT (see Appendix 2). In recent months, more and more islands have taken advantage of this possibility. However, closer cooperation seems necessary, especially in terms of document delivery to Pacific island nations.

6. OCLC (ONLINE COMPUTER LIBRARY CENTER, INC.)

Located in Dublin, OH, OCLC is a union of more than 13,000 libraries and library systems, including the Asia-Pacific region, providing bibliographic access to more than 33 million records stored on 17 Tandem mainframe computers. The OCLC interlibrary loan subsystem functions as the U.S.'s major electronic book lending clearinghouse and document (journal articles) delivery system for its member libraries, with an average turn-around time of two weeks per item. The lending of books is usually free (except for postage, telecommunication and system use charges), while the average cost for a journal article is about five dollars.

7. RESOURCES ON THE INTERNET

The INTERNET is a vast system of computer networks spanning the globe. While most people may primarily think of it as an electronic mail system, it is much more than that. Some of its other functions are to permit file transfer between different hosts and remote login, which allows connecting to a remote computer. The latter is perhaps the most appealing for researchers.

In 1989, the first library online public access catalogs (OPACs) began to appear on the INTERNET. Since then, several hundred libraries from around the world have provided access to

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their holdings databases through this network. Institutions thus accessible include, in the U.S.: UC Berkeley's GLADIS, Stanford University's SOCRATES, Harvard University's HOLLIS, the Cornell, Princeton and Columbia universties' online library catalogs, ORBIS at Yale University, entire library systems like MELYL in California and the CARL system discussed earlier; in the U.K.: OLIS at Oxford University and the Cambridge library catalog; in Australia: the Australian National University Library; as well as libraries in Sweden, Germany, Switzerland, and many more. For a listing of library catalogs accessible via the INTERNET (and the procedures for connecting), please refer to the Appendix of this paper; especially handy is the memory resident hypertext program written by Peter Scott from the University of Saskatchewan.

And there is more. What was said about CARL is also true for many other library systems: they don't just have their library's holdings, but often have special indexes, bibliographies and full-text databases. For example: on the Dartmouth College Library System, you will find the full-text of the King James version of the Bible, the full-text of all of Shakespeare's sonnets and the full-text of 33 of Shakespeare's plays (with separate summaries and other value-added features); on the Carnegie-Mellon system, you will find an index to architectural illustrations; on the University of Saskatchewan system, you will find an index to Canadian Business and Current Affairs.

And there is more. And most of it is free - although sometimes perhaps unintentionally: many of the library systems include commercial databases and access to them is usually limited to persons associated with that institution and usually requires a password - but sometimes it doesn't and sometimes the password is rather obvious ....

And there is more. Through the INTERNET, you can access more and more of the commercial online database vendors discussed earlier, like STN and LEXIS/NEXIS and thus save telecommunications charges you would incurr using fee based services like Tymnet or SrintNet (formerly Telenet).

And there is more. There are other databanks available, which are neither part of a library system nor reside on a commercial host, like the ATI-Net (an agricultural market and trading information systems) or OCEANIC (a database for marine sciences) or the NASA space shuttle schedules or a nationwide weather forecast, etc.

And there is more. There is the Cleveland Freenet (and other freenets and bulletin boards), which is a community computer system, operated by Case Western Reserve University, and offers among many, many other things also a full-text database of the United States Supreme Court opinions.

And there is more. Although we don't yet live in the land of Xanadu as envisioned by Ted Nelson for electronic publishing toward a "docuverse", more and more scholarly journals appear in electronic form, and only in electronic form. Please refer to the index listed in the Appendix.

And there is more, to explore on the INTERNET.

8. CONCLUSION

This paper was about possibilities -- not realities. And indeed, there are many viable options for distance research which begin to reduce the time an energy expended on identifying and obtaining research materials so that more time and energy may be expended on their critical analysis.

Incidently, in the course of research for this paper, I came across a reference to a journal article which promised to be of some relevance. Unfortunately the issue had been sent off to the bindery by our library. I could have ordered a copy of the article through UnCover via fax, but it would have cost $ 9.50 ....

But even if cost should turn out not to be a factor in information access, "the fact that it is technically possible for information to be available to everyone at little cost in no way ensures that it will be." (5)

9. NOTES

(1) Godfrey, David and Douglas Parkhill. Gutenberg Two. Toronto, Canada: Porcépic, 1980. p. 1.

(2) The CD-ROM Directory. Fifth Edition. London: TFPL Publishing, 1991 (paper version); Capitola, CA: UniDisc, 1991 (CD-ROM version).

(3) Neufang, Ralf and Carol Tenopir. "Electronic Reference Options: How They Stack Up in Research Libraries." Online, March 1992 (forthcoming).

(4) Directory of Online Databases. Detroit: Gale, 1991. p. v.

(5) Poster, Mark. The Mode of Information: Poststructuralism and Social Context. Chicago: University of Chicago Press, 1990. p. 72.

10. APPENDIX 1: ADDITIONAL INFORMATION SOURCES

CD-ROM:

1. CD-ROM Directory. 5th ed. London: TFPL Publishing, 1991.

2. CD-ROMs in Print 1991: An International Guide. Compiled by Norman Desmarais. Westport, CT: Meckler, 1991.

Online Databases:

1. Directory of Online Databases. Detroit: Gale, 1991. (Quarterly updates)

Electronic Journals:

1. Directory of Electronic Journals, Newsletters and Academic Discussion Lists. Compiled by Michael Strangelove and Diane Kovacs. Washington, D.C.: Association of Research Libraries, 1991.

Library Catalogs on Internet:

1. St. George, Art and Ron Larsen. Internet Accessible Library Catalogs and Databases. Albuquerque, NM: University of New Mexico, 1991. (available by e-mail message "get library package" to listserv@unmvm.bitnet)

2. Barron, Billy. UNT's Accessing On-Line Bibliographic Databases. Denton, TX: Univ. of North Texas, 1991. (available on Internet by anonymous FTP on host vaxb.acs.unt.edu)

3. HYTELNET 4.0, 1991. (a memory resident hypertext program) Peter Scott. University of Saskatchewan Libraries, Saskatoon, Canada.

11. APPENDIX 2: PEACESAT SITE INFORMATION (curtesy of Lisa Poulos, Operations Manager, PEACESAT, UH)

The following sites currently have connecting capability to the UH Computing Center and thus to the UH library system via PEACESAT: Fiji, Guam, Honiara (Solomon Islands), Majuro (Marshall Islands), Malifa (W. Samoa), Noumea (New Caledonia), Pago (Am. Samoa), Palau, Port Moresby (PNG), Pohnpei (FSM), Saipan (CMNI), Tonga, Port Vila (Vanuatu), Yap.

Development of Integrated Multimedia Telecommunication Utilization for Project Management: The International Network for Education in Science and Technology Project (NEST).

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1. ABSTRACT

Integrated multimedia technologies are making possible complex project coordination of widely-scattered entities. This paper addresses pilot application of such techniques for an educational science curriculum program: The Foundational Approaches in Science Teaching (FAST). The International Network for Education in Science and Technology (NEST), which is based on the FAST program, seeks to increase global understanding of the environment and a global ethic of responsibility for nurturing that environment on national and international bases. Current efforts involve extending integrated, multimedia telecommunications resources and techniques to the project development, testing, dissemination, feedback and evaluation phases. Early efforts at such activities on an international basis in NEST are described in this paper.

2. BACKGROUND

2.1 MULTIMEDIA COMPUTER-BASED EDUCATIONAL TELECOMMUNICATIONS (CBET)

Being isolated from all major population centers has stimulated the development and utilization of telecommunication resources in Hawaii. In the early 1970's the University of Hawaii, in cooperation with Pacific basin countries and the United States National Aeronautics and Space Administration (NASA), pioneered in developing a grass-roots, international educational satellite program called Pan-Pacific Education and Communication Experiments by Satellite (PEACESAT). PEACESAT began in 1971 through use of the ATS-1 and ATS-3 communication satellites under the direction of NASA.[1]

An early example of the integrated, multimedia approach was a series of programs based on the American Field Service international student exchange program. Returning students gave live presentations over PEACESAT accompanied by duplicated, colored slides on PAFSPECS (Pan-Pacific PEACESAT Educational Communication System).[2]

Later electronic computer mail provided a convenient, asynchronous messaging capability in planning for multimedia events over PEACESAT or telephone. This began to be used in the early 80's. In the mid 1980's the Hawaii Global TELEclass Project.[3] integrated videophones and electronic mail to enrich foreign language classes in Hawaii and around the world. Students could practice written and spoken communication via computer mail and speakerphones, respectively. NASA's newly-developed agreement to use the GOES3 satellite should make possible a new era of multimedia capabilities for PEACESAT and its users. Not only voice but facsimile, computer data, and video slow scan images can be transmitted quickly to regions throughout much of the Pacific.[4]

These are among the resources foreseen as having potential for coordination and operation of the International Network for Education in Science and Technology (NEST). Originally funded by the Hitachi Foundation, NEST has been establishing links between schools in New Jersey, North Carolina, Maine, Minnesota, Hawaii, Texas, Russia, Singapore, Indonesia, Hungary, and Japan that are currently using the FAST program. It is thought that NEST is the first educational telecommunications project based on a successful, existing science curriculum program. [5]

2.2 INTRODUCTION TO NEST

The International Network for Education in Science and Technology (NEST) project is designed to develop cross-cultural awareness and an international communications network that addresses global environmental concerns and facilitates collegial exchange among science teachers. This three-year project, funded by the Hitachi Foundation, is a collaboration of the Center for Pre-College Programs, New Jersey Institute of Technology (NJIT), and the Curriculum Research & Development Group (CRDG), University of Hawaii (UH).

The objectives of NEST are to

1. establish a network of national and international contacts for collecting, analyzing, and sharing environmental data.

2. develop investigations concerning the environment that will be global in concept and content and can be adapted to various cultures.

3. provide an opportunity to identify and test activities for collection and comparison of globally relevant data.

4. encourage understanding and respect on the part of both students and educators for cultural differences and how they may affect problems and solutions to global concerns

Students involved in the pilot program communicated with one another via the Electronic Information Exchange System (EIES), sharing data they collect on environmental topics such as weather patterns, acid rain, soil analysis, ozone depletion, and similar topics. Data collection is coordinated by the primary sites at the University of Hawaii and New Jersey Institute of Technology.

Participants use the Foundational Approaches in Science Teaching (FAST) program. FAST was developed by the Curriculum Research and Development Group of the University of Hawaii College of Education. FAST is an interdisciplinary, environmental science program which emphasizes foundational concepts and methods of physical, biological, and earth sciences and relates them to practical issues of human use of environments. FAST is an accredited science program used by over 500,000 middle school students in the U.S.A. and overseas. FAST gives students a sense of the operations of our modern, scientific community by directly involving them in processes of inquiry and research.

Videotapes of classes are exchanged to provide a visual image of the students involved and the different environments being studied. Data are collected during the same periods of time, uploaded onto the EIES system, and compared by classes in diverse areas.

NEST invites middle school teachers and their students to share environmental data. Through "hands on" activities science teachers can more readily address current ecological issues and by using telecommunications can give their students valuable technological experience and awareness of global issues.

2.3 PROJECT HISTORY

NEST grew out of previous work at the University of Hawaii and NJIT. Project MENTOR (Marine Education Network to Organize Resources) was an early cooperative science project using telecommunications that began in 1981. Project MENTOR was established by Barbara Klemm and John Southworth at CRDG as part of a National Science Foundation Information Dissemination for Science Education grant. It provided an opportunity to explore possibilities using computer systems and other forms of telecommunications among marine educators in the United States and overseas. [6, 7]

In 1984 Howard Kimmel and Mark O'Shea developed a project with middle school teachers in New Jersey. They began work with the idea of using the Electronic Information Exchange System (EIES) to support the implementation of American Association for the Advancement of Science (AAAS) materials called *Science Resources for Schools* (SRS).[8] Their project, known as the *Middle School Improvement Project* (MSIP) was approved by AAAS as a special dissemination project studying the effects of using workshops plus computer conferencing to implement curriculum activity packets. After the SRS project was completed, Kimmel and O'Shea developed a model for continuing in-service for their teacher group which included:

- Saturday morning workshops held once every three weeks to learn content and explore activities related to one or a few themes
- EIES support to address teacher and student questions and provide for joint data collection
- visits to schools to support the teacher's local efforts in their own environment (political and technical support).

The NEST project evolved from the success of MENTOR, MSIP and the in-service teacher group's curiosity to share their data with other areas of the world. In 1988 Kimmel contacted John Southworth and Donald Young at the Curriculum Research & Development Group (CRDG) of the University of Hawaii to explore interest and ideas for developing a proposal for an international telecommunications project. A three-year grant from the Hitachi Foundation was successfully obtained and in the fall of 1989 the project was launched.

NEST now unites an international network of middle-school teachers and their students using EIES as the communications vehicle and FAST as the instructional base. Project investigations include such topics as rain forest degradation, air and water pollution, solid and toxic waste disposal, demise of species, the greenhouse effect, and other environmental areas with international implications. NEST investigations are designed to supplement the science program, not replace it.

3. NEST OPERATION AND COMPONENTS

3.1 TARGET POPULATION

The target population for this project includes middle-school students and teachers using the FAST program. In FAST these students have already developed the skills of data collection, the ability to analyze and understand the data collected, and an ability to begin to develop an awareness of the global impact of environmental issues. This is an ideal age to impress on students the importance of informed decision making about environmental issues, to develop global awareness of such issues, and to begin to develop an awareness of cultural perspectives on these issues.

FAST was also selected because of the diversity of locations available for data collection. FAST has been named an exemplary science program by the National Science Teachers Association and is a validated project by the National Diffusion Network. It has been adopted by schools in 36 states and is also used in schools in the Virgin Islands,

Pohnpei, Kosrae, Australia, Japan, Abu Dhabi, Singapore, Indonesia, and Hungary. These various locations can provide environmentally diverse data as well as an opportunity to develop global understanding of environmental issues and cultural diversity.

3.2 INTERNATIONAL PARTICIPATION

Three international participants who were experienced FAST teachers, two from the Republic of Singapore and one from Budapest, Hungary, were invited to participate in piloting NEST. Nishinippon Junior College High School in Fukuoku, Japan, Sohseikan Senior High School near Nagasaki, Japan and Gakushuin Senior High School in Tokyo, Japan, were also invited to join NEST in 1990. Moscow schools were successfully involved through the efforts of Southworth. Future potential participants include teachers in France, Jakarta, Micronesia, and Australia.

3.3 FAST

The *Foundational Approaches in Science Teaching* (FAST) program is a second-generation inquiry science curriculum designed specifically for middle-school students. FAST has been designed to enable students to replicate the activities characteristic of the science disciplines at a level appropriate to the developmental stages of 12 to 14 year-olds. Content is organized into three strands called physical science, ecology, and relational study. Relational study focuses on the interrelationships of the science disciplines and the interactions of science and society. The program consists of three, one-year courses intended to be studied sequentially.

The goal of FAST is the development of a scientifically literate student who has 1) the background necessary for understanding the environmental concerns arising in our technological society, and 2) the foundational tools for further study in the sciences. The principle objectives of FAST are to develop thinking skills, laboratory skills, and knowledge of foundational concepts of the disciplines of science. [9]

FAST instructional strategies were designed to take advantage of the major characteristics of middle-school students—their high energy level and curiosity, their need for social interaction, and their developing ability to deal with abstract thinking. Students work in small groups where they are encouraged to talk with one another about their experiences and ideas, thus directing their need to talk toward meaningful communication and learning. The developmental structuring of FAST begins with concrete, real experiences from which students derive concepts and language, thus facilitating their development of abstract thinking. [10]

3.4 FAST and NEST

Of particular importance to the NEST are the ecology and relational study strands of the FAST program. Students learn how to collect environmental data, to analyze it and to report their findings. They also learn how to use reference material to supplement their studies. The relational study strand serves several purposes within the program. Its content is drawn from the fields of philosophy and history of science as well as from the study of current environmental issues. Further, the relational study graphically demonstrates the connections between the sciences, technology, and the world of the citizen. At the end of each of the three courses there is a relational study unit that is designed to cause students to draw on all their experiences in physical science and ecology and to apply their new knowledge to the study of an environmental issue.

Relational study exposes the limitations of scientific knowledge in the arena of social decision making. The input of the sciences is seen as but one of the many factors (moral, ethical, aesthetic, economic, political, and others).

Students using FAST already collect local environmental data on soils, weather, air quality, water quality, food production, incident solar energy, land use, resource depletion, and population growth as part of their studies. However, before NEST no mechanism had been available to enable students to share and compare environmental data. Utilizing the EIES system provides that valuable component.

3.5 EIES

Since the early 1970s scientists and engineers have used wide-area telecommunications as one method of communicating with each other. The Electronic Information Exchange System (EIES), a computerized conferencing system based at the New Jersey Institute of Technology, was developed under National Science Foundation sponsorship specifically for this purpose. Its advantages include participation at the site, time, and pace of the participants' choice, a variety of experts as resources, interaction with peers and experts, a written transcript of the proceedings, and minimal costs compared with telephone, mail, and travel. With the computer used to store and organize their communications, participants are able to carry out a variety of projects despite the fact the they are located in different states and/or countries.

Public access networks [e.g. Sprintnet operated by US Sprint] have many host computers (e.g. EIES) sharing their lines and saving communication costs. In addition, they have local nodes in many towns and cities, thus saving long-distance charges to reach the host computers. Bitnet and Internet are international networks linking educational, governmental and research institutions around the world. Networks such as these are becoming increasingly common in schools which generally subscribe to them for access to electronic mail, computer bulletin boards, private and public data banks, and services that distribute curriculum guides. Once a computer conferencing system is established the potentials for structuring, facilitating, and augmenting the communication and information exchanged among members of a group are virtually unlimited.

4.0 NEST PROGRESS

4.1 1990-1991 ACTIVITY

During the summer of 1990 CRDG developed and distributed a NEST manual. The manual contained instructions for accessing EIES, information about uploading and downloading procedures, selected FAST investigations, a timeline for completing the environmental investigations during the academic year, and information on member sites and international time zones. Additional materials were prepared or purchased and sent to members as needed to facilitate involvement in the project.

Accounts for participants in the electronic conferencing system were established in September 1990. Communications nodes were also established in two locations in North Carolina, one location in Minnesota, one location in Maine, and three schools in Japan in addition to the expansion of sites in New Jersey and Hawaii. Teachers' first log-ins occurred from September to December 1990.

4.2 GREETINGS

The development of confidence and rapport among members is critical to the successful implementation of collaborative activities. [11] This is especially true in electronic communications. With this in mind, "electronic greeting" messages were sent on EIES to provide a warm, personal touch and encourage participants to use the electronic network.

As an additional communications enhancement VHS tapes called "Hello Tapes" were developed at each site. Each teacher and their class introduced themselves and their environment via a brief segment on a videotape. The videotapes were then circulated to the other sites.

4.3 NEST NEWSLETTER

A newsletter published twice a year was established to share ideas among the students. Articles were written by students and sent over EIES to the New Jersey-based editor. Students were encouraged to think "globally" so that an exchange among the culturally diverse participants at the different sites could be maintained.

4.4 PROGRAM IMPLEMENTATION

It seemed appropriate to start the curriculum effort with the New Jersey group of teachers who had worked together previously and had Kimmel and O'Shea close by to help with any questions that arose. The New Jersey teachers began an initial evaluation of activities for students at different locations to share ideas and concerns of a regional and global nature. The selected activities initially included such topics as acid precipitation, water resource management, the greenhouse effect, solid waste management, and oil spills. Several activities involving solid waste management were explored. In one school, various video media and a values clarification slide presentation were used by the students to record perceptions of litter and the importance of a litter free environment. NEST implementation was much slower in areas outside New Jersey due mostly to inexperience with EIES.

5. FORMATIVE STUDY OF THE NEST PROJECT

5.1 INTRODUCTION

In order to evaluate the project's progress and offer recommendations for further development, CRDG conducted a formative study. [12] Two mail surveys and telephone interviews were conducted with each site to determine the strengths and weaknesses of the project.

The research had four general goals:

- to determine the extent to which the project has succeeded in promoting teaching and learning about environmental issues;
- to identify the variables that influence the NEST conference and to compare the growth of the NEST conference with that of other conferences in the EIES system;
- to determine the problems and promises of communicating on-line with other countries;
- to develop recommendations about management of the project and ways to facilitate and motivate participation by drawing upon these findings.

5.2 FINDINGS

Findings were described in three categories—level of conference use, environmental content of exchanges, and member considerations. NEST did provide a channel of communication and exchange of environmental data among members. Of the comments entered in the NEST conference by the end of February 1991, 62% were on environmental issues.

Members perceptions of the project were encouraging. Although many were unable to use EIES efficiently, 100% were enthusiastic and excited about the project. Opinions of international members are unknown, yet their repeated attempts to access EIES indicated interest in the project was still present.

5.3 VARIABLES AFFECTING PARTICIPATION

Three variables appeared to affect NEST participation. These were categorized as technical, social, and topical.

5.3.1 TECHNICAL

Differences in EIES computer training proved a factor in the level of participation during the 1990-91 academic year. The New Jersey teachers working with Kimmel had the opportunity to meet and get EIES training at the New Jersey Institute of Technology. Other participants in NEST were generally unable to receive such training because of their diverse geographic locations. As a result, these participants were less frequently on-line than the New Jersey-based group.

In addition, the accessibility of telecommunications equipment affected rates of participation. Access to EIES can also be seen in terms of cost barriers, convenience barriers, and barriers derived from the degree of previous experience with and knowledge of EIES. These factors affected member participation rates. For example, the most active participants had telecommunications equipment easily available while the least active members reported access to equipment was difficult.

Admittedly, some of the technical problems of telecommunications are inherent in the medium. A characteristic of computer-based conferencing is that messages are stored in the host computer until it is convenient for members to receive them; therefore, the time lapse between the entry of a comment and when it is read by each member is

unpredictable. This implies that it should not be used for information needed immediately. This resulted in two sites reporting they felt "left out" because their requests for help and more information were not responded to until a month after their messages were sent.

Local technical problems were also a factor impeding participation. Teacher participants had varying brands of computers, modems, and software. This made it difficult for CRDG to assist all members having difficulties. Most of these problems were with software. The telecommunications software available today can be confusing and may appear very complicated. Many network companies, TERC for example, are developing their own software so people with general computer experience can use their networks.

Although many previous studies [13,14,15,16,17,18] emphasized the importance of an active and structured moderator for producing successful group discussions, the moderator of the NEST conference was not active. The moderator issued no warm invitations, sent no encouraging messages to compliment individual members or comment on their entries, and did not suggest what they may be uniquely qualified to contribute.

5.3.2 SOCIAL

Most NEST members were not familiar with each other. EIES, however, features a directory that lists names, addresses, a brief description of members, and when members were added to the EIES system. There was a great difference in the activities of members previously familiar with EIES and the new members. All of these new members reported being intimidated by the number and content of messages generated by experienced EIES users within the conferences they viewed.

In addition, unlike previous computer-based communication programs there were no common meetings among members, no regular visits by administrators and few other ways to acquaint teacher participants with procedures.

Since the average rate at which members logged-in was less than once a week, a long period of EIES use was necessary for members to get to know other members through their messages alone. During the telephone interview, teacher participants stated that a common meeting would increase participation. The Hello Tapes and NEST Newsletter were important factors because they acquainted members with EIES and each other.

5.3.3 TOPICAL

Private and conference message topics play a critical role in the beginning of interaction in computer-based communications. [17] In a face-to-face meeting, an introduction, or sheer proximity, may inspire interactions to begin. In computer-based communications proximity is irrelevant and the content of the messages must determine whether interactions will begin.

Participation then rests on topics of discussion that are interesting and relevant for the community of members. Unlike previous studies, NEST focuses on topics from a common science and problems with the topics of study were not found. Sixty-three percent of all teacher participants were trained FAST teachers, and the most active member, a teacher participant not trained in FAST, completed four FAST investigations. Eighty-five percent reported collecting data on target FAST investigations yet only 15% entered the data in the system. Clearly, technical difficulties overshadowed topical problems.

In addition, it should be noted that Kimmel has operated on the assumption that face-to-face contact is essential in establishing a network. Over the next year of the project Kimmel's assumption of personal contact will be tested against the counter assumption that interesting and relevant content will inspire participation.

6. INTERNATIONAL DEVELOPMENTS

6.1 INTRODUCTION

CRDG was largely responsible for the support and progress of the Japanese and Russian participants. Both the Nishinippon and Gakushuin contacts were English teachers and the Sohseikan member was an administrator. It was anticipated they might lose interest or feel left out if science was the only topic of communications. Therefore, CRDG made extra efforts to make them feel welcome.

Although the international communications on EIES were rare, the fact that most were able to access EIES is encouraging. It was also discovered that they had different expectations and uses for the project. Once this was realized, ways to accommodate both the project and the site were considered.

6.2 MULTICULTURAL PERSPECTIVES INTRODUCTORY COMMENTS

It was also important for participants to become aware of the impact of electronic communications on the discussion of different cultures since the technology may tend to blur cultural differences. By its nature the medium precludes the presence of features that constitute the context of face-to-face interactions. These include the relevance of setting, situation, physical attributes of participants, and speech characteristics. Normally such features strongly contribute to the context for not only interpreting the meaning but also to the value of what is being said. [11] Indeed cultures often attribute different meanings to metaphors and other expressive forms of language.

Moreover, different cultures may also develop their own unique adaptations and applications of the technology. Yet, the increasing political and economic-based interdependencies between cultures and nations will require increased intercultural communication and understanding. NEST schools in the U.S. from urban, suburban, and rural areas also provided a cross-section of America with variations in environment and resources. The following are examples of international participation from the USSR, Japan, and the USA.

6.2.1 USSR: MOSCOW SCHOOL TELECOMMUNICATIONS NETWORK

The Soviet Academy of Sciences has been advocating the use of computers and telecommunications for several years. Several entities within the Academy have been working with local schools and community groups to develop international contacts. The Moscow School Telecommunications Project (MoSTNet) is one of them which has been associated with the NEST project during the past two years. [19]

In 1988 the Academy launched an international cooperative project called the New York State - Moscow School Telecommunications Project. Alexander Uvarov has led the project to study the "problem of introduction of new informational technologies into the school and their interaction with the rapidly-developing process of integration "the rapidly-developing process of integration of new content and new educational means with the traditional approaches." [20] In the summer of 1989 a conference held in Moscow gave the participating teachers from both countries the chance to get acquainted personally as well as to begin planning their joint activities.

The project involved use of both asynchronous computer communication with electronic mail as well as synchronous videotelephone exchanges. The computer provided the mainstay of the communication and permitted convenient planning of the periodic videophone exchanges.

Initially, the project involved pairing of schools with sister schools and subsequent exchange of electronic mail by computer networks. Subsequent videophone exchanges were planned for a frequency of two-to-three times a semester. The final mode of experience is seen as that of student and teacher exchanges to permit face-to-face communication.

The development of a "telecomcenter" in the form of MoSTNet took place during the summer of 1989. MoSTNet exists to help tutors, learners and their educators to make good use of the various available new technologies. The center gives courses and workshops as well as consults on all aspects of hardware, software and educational content for networking activities.

An interesting set of criteria for selection and evaluation of student generated projects to lessen the possible contradictions and misunderstandings was developed by MoSTNet.

1) E-mail is of vital importance for cooperative projects.

2) Projects should be jointly-supported endeavors involving both schools.

3) Each side should be prepared to help promote mutual understanding and cooperation on the project.

4) Students should follow the pattern of laboratory researchers as they conceive and organize problem-solving endeavors.

5) Simple, clearly-throught-out projects should be featured.

6) The students should gain knowledge, skills, and attitudes from participation in such projects of a practical nature.

7) Projects must be well-structured and well-defined.

8) The time limit should not exceed 4 months.

9) Projects should be self-supporting and rely on equipment available at the school.

10) The project should be open to all those who are available

6.2.2 JAPAN: SOHSEIKAN HIGH SCHOOL

Sohseikan is a private school with approximately 1,500 students mostly from the Nagasaki Prefecture. A large proportion of students graduating from the school directly join the work force rather than continuing immediately in college. Priorities for the school include telecommunications, information sciences, and English language. There are ten classrooms with about 450 microcomputer terminals linked to their host computer system. There is a library of computer related information in magazine form in the host computer room. The school has a movable satellite receiver to access American and Soviet television and weather satellites. This is used for getting international information and movies from overseas. In the computer education curriculum there are topics of computer graphics, programming, and hardware/software education. The school is wired for closed-circuit television in basically every classroom. The audiovisual room contains the TV system control and studio. There is a learning lab in five of the ten computer classrooms including overhead projection, audio tapes, computer-based attendance, and VCR units. There is an image scanner for computer graphics and a voice analysis system to monitor speech patterns. This extensive list of resources makes Sohseikan among the leaders in use of educational technology at the secondary level in Japan. Because of this, Sohseikan frequently sponsors or hosts computer seminars. In the past year international electronic mail and videophone use have begun.

Junichi Nozato is Sohseikan's telecommunications specialist. He is primarily responsible for the design and set up of its computer system. He designed a computer table which features a collapsible top which doubles as a desk when lowered. He is also responsible for the planning and development of Sohseikan's telecommunication and information science curriculum. Nozato is also the director and adminstrator of the telecommunication and information science curriculum.

6.2.3 TEXAS: SANGER INDEPENDENT SCHOOL DISTRICT

The FAST Program is utilized by over 100 8th grade students at the Sanger Middle School. The 8th grade science teacher, Debbie Bennett, has a fully equipped science lab consisting of the normal science equipment, but also the lab is equipment with a computer that is networked with the campus system. A HAM radio station is presently be installed. The ecology portion of FAST was selected by Sanger because of our involved with the National Weather Service in Fort Worth, Texas. Sanger is a coorporating weather station with students actually running the weather station.

It was also felt that since the Director of Technology, David Moore (eies206), supervises all technology related functions, he should be on the NEST system. With his connections to other systems around the world, Sanger will not only be utilizing the FAST/NEST/EIES2 system, but connecting with other schools to share data.

Both Debbie and David connect to EIES2 via TENET, the new Texas Education Agency Network. This system allows Sanger to connect via Internet to the NEST Network.

6.3 JOINT PROJECTS EXPERIENCES

6.3.1 USSR: MOSTNET

In June 1990 MoSTNet joined the EIES network and took part in an exciting and innovative tri-nation videoteleconference between the USSR, Japan, and Hawaii. This led to periodic EIES exchanges with NEST participants, including publication of Moscow students' articles in the NEST

Newsletter. During the presentation of this project at the 1991 PTC Conference, a group of students and their parents joined the MoSTNet staff until 1 a.m. in the morning to join in via videophone during the PTC session to provide a vivid example of the dynamic potentials of telecommunications for educational projects. [21]

MoSTNet has been developing telecommunications with the concept that the teacher's role will change from that of the main source of information to one of being a partner in the research efforts.

In recent months there has been difficulty in maintaining regular contact due to the change of computer systems from EIES1 and EIES2 as well as network differences. As this article goes to press other NEST project participants are all hoping the economic and technical challenges will not preclude continued activity by those in the USSR.

6.3.2 JAPAN: SOHSEIKAN

For the past three years Sohseikan has had a sister school relationship with the University of Hawaii Laboratory School. In late March of 1991, Alfred Kina went to Sohseikan as the first exchange teacher from the Lab School. Kina instructed English conversation although his college major was Fine Arts. Under the guidance of John H. Southworth, one of his primary aims was to assist the implementation of Sohseikan's newly-subscribed EIES system. Together with Nozato, they successfully accessed EIES surmounting obstacles from budgetary restraints to system accessiblity. They also were able to successfully participate in videophone conferences with the Laboratory School and other continental mainland sites. Although the nature of the videophone conferences included primarily NEST themes, Sohseikan's full participation as a NEST member was limited because the limited English capability junior high school students' and teachers.

Nozato and Kina hurdled many obstacles in successfully linking up to EIES and to implement other telecommunication projects. But in spite of the difficulties encountered in the process, they have come a long way since last March. With Nozato's engineering, electronics and technical knowledge, and Kina's interpersonal relationship skills, they have managed to complement each other's strengths in providing a stimulating, and challenging multimedia telecommunications system. Both agree that the key to a successful telecommunication system is the 'human element'. "One can have the most sophisticated hardware in the world, but if noone uses it , it doesn't mean anything." is one of Kina's favorite sayings. Kina considers himself a bona fide telecommunications specialist because, although he doesn't have the technological background, he is able to successfully plan, coordinate, and moderate telecommunication events.

6.3.3 TEXAS: SANGER

Sanger had some problems implementing the FAST curriculum during the 1991-92 school year. There was a change over of teaching personnel. The potential of FAST is unlimited. The fact that schools from around the world can connect and SHARE date and complete the same experiments is beyond the standard textbook science classes. NEST allows students to DO science, not just read about it. Sanger has not realized the true potential of FAST. In the coming months and years, Sanger believes that students will see the need for science education and see the future life-skills for science exploration.

7. '91-'92 FAST-NEST

Having established the effectiveness during the pilot project last year, the project is expanding into the FAST-NEST project to launch additional FAST sites, activities and personnel.

In the summer of 1991 a number of steps were taken to improve upon the pilot project. Building on the findings from CRDG's formative study, a revised plan for 1991-92 was established. Critical elements for the coming year include 1) determining procedures for using and testing the capabilities of EIES, 2) securing and training a HI-NEST conference moderator, 3) developing and disseminating a HI-NEST manual, and 4) inviting FAST-certified trainers to participate.

A major step has been the retirement of the EIES1 computer and transfer of all operations and users to EIES2. This has been taking a lot of time to retrain EIES1 users and give some training to new FAST-NEST participants.

Invitations have been extended to all FAST-Certified Trainers to begin networking on EIES2. Separate conferences have been set up for the student, teacher and trainer activities. A mix of post, phone, FAX and personal visits have been employed in launching FAST-NEST. It is hoped that the trainers can gain experience and eventually include telecommunications skills and operations as part of the regular training program. New materials are being developed and reviewed while the existing ones are being revised.

New conferences for multicultural holidays and traditions and one for technical projects have been gaining popularity, especially as our number of international users increases.

Plans for continuation are pending development of grants and/or local school funding through budgetary, special projects, or other modes of fund-raising. Hopefully, this will lead to the ability to launch a broader model project as described in the next section.

8. THE HI-NEST PROJECT

The enthusiasm of the NEST pilot project participants and the need for FAST trainers, teachers and students to communicate with one another on environmental and program issues have led NEST developers to expand the project. The expanded project, to be known as HI-NEST, will continue with the national and international communication on environmental themes including more environmental investigations, a new computer-based communication system, additional national and international sites, and a channel of support services for the rapidly increasing population of FAST users.

8.1 COMMON ENVIRONMENTAL SCIENCE PROGRAM

FAST will be the common program uniting project participants nationally and internationally. FAST is already being used by students and teachers in 36 states and various international sites providing a rich diversity of locations for environmental data collection.

FAST has been named an exemplary science program by the National Science Teachers Association and is a validated Project by the National Diffusion Network. It has been adopted by rural, suburban, and urban schools throughout the United States and is also used in schools in the Virgin Islands, Pohnpei, Kosrae, Australia, Japan, Abu Dhabi, Singapore, Indonesia, and Hungary. The diversity of

adoptions demonstrate the program's adaptability to different environments and cultures. These various locations provide opportunities to develop global understanding of environmental issues and cultural diversity.

8.2 ELECTRONIC INFORMATION EXCHANGE SYSTEM

The EIES system used for the pilot project began operation in 1975 and was found by participants to be difficult to use. However, NJIT has developed a new system, EIES 2, which promises to be state of the art and easier to use. EIES 2 was available for use beginning in July 1991 and members of the pilot project were transferred to the new system in August. NJIT distributed a general users manual which will be revised in light of response from users. Advanced use of EIES 2 is currently being investigated and NJIT has establish separate conferences for the HI-NEST project. The first conference will be for reporting, analyzing and discussing student data, the second for project teachers to communicate with one another, and the third for FAST-certified trainers to confer with one another and with teachers they have trained. Membership will be determined by the project moderator.

8.3 THE HI-NEXT MODEL

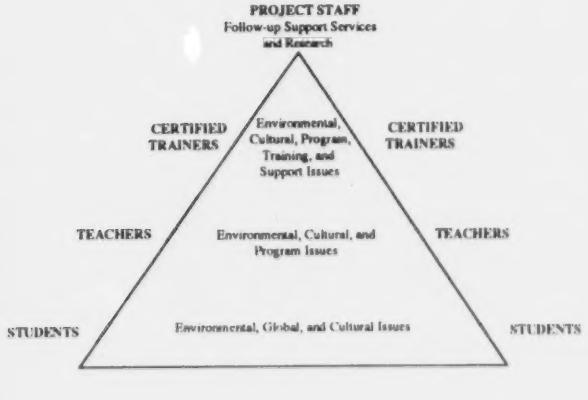
The FAST program is growing at an unprecedented rate. Over fifty teacher institutes were conducted during the summer of 1991. This brings the number of FAST-trained teachers to nearly 4000 and the number of FAST students in 1991-92 to over 290,000. Projected figures indicate that by 1995 over 8,000 teachers will be teaching FAST to more than 600,000 students.

Project staff view HI-NEST as a powerful support tool to ensure the success of FAST as it grows and provide for meaningful interactions among FAST and nonFAST teachers. HI-NEST will provide a progressive network whereby project staff can more readily support all teachers and trainers involved with the program. Not only will teachers and students benefit from an understanding of global issues and communications technology, they will be linked with their peers from around the world.

The HI-NEST project is based on a hierarchy of users engaging in increasingly complex and rich sets of interactions. These are described in Figure 1 below.

FIGURE 1

HI–NEST MODEL



8.4 STUDENT CONFERENCE

Through the student conference HI-NEST provides students the opportunity to share environmental data and observations, collaborate on ideas, and conduct research with other students throughout the United States and around the world. In so doing, students develop an awareness of the global environment and multicultural perspectives in dealing with global issues. In addition, they replicate the process of scientific inquiry as it exists today, giving them the experience of practicing scientists.

8.5 TEACHER CONFERENCE

Participating teachers working with their students share the benefits of conducting research and sharing environmental data on a national and global basis. In addition, HI-NEST provides a network whereby teachers can communicate regularly with one another and with project staff about program issues.

8.6 CERTIFIED TRAINER CONFERENCE

Teacher institutes and follow-up support services are an integral part of the FAST program. Classroom sets of materials are only made available to teachers who have been trained to use them. FAST teacher institutes are a combination of theory and application which includes intensive study and engagement with the FAST program. Teacher institutes are conducted by FAST project staff and certified trainers. These trainers are experienced, highly motivated FAST teachers who have had additional training from FAST experts in conducting teacher institutes.

The HI-NEST certified trainer conference will serve multiple purposes. First, since all FAST-certified trainers are also classroom teachers, they too will share in the excitement with their students of engaging in study of globally relevant issues and communicating with other FAST students and teachers worldwide. Second, the HI-NEST will create a network of certified trainers who can communicate regularly with one another and with project staff about training and support issues relevant to providing timely and up-to-date teacher institutes. Third, HI-NEST will provide an opportunity for certified trainers to communicate with and support those teachers that they trained in FAST teacher institutes. Fourth, all FAST-certified trainers will be active EIES users and will incorporate EIES training into the FAST teacher institutes they conduct.

9. CONCLUDING REMARKS

Thus FAST-NEST and HI-NEST are providing practical models for applications and testing of developing modes and techniques of integrated multimedia telecommunications. This project, while related to a specific science education activity, could play an important role in research and development of ways in which telecommunications can aid many types of educational, business, governmental, and community service programs. It is hoped the coming years will involve development of effective partnerships with business and other educational entities that would benefit from the sharing and exchange of information that is emerging from this new and innovative endeavor based upon international cooperation.

10. FOOTNOTES

[1] See Kingan, et al., 1990
[2] See Southworth, 1977
[3] See Wollstein, 1986
[4] See Taylor, et al., 1992
[5] See Young, et al., 1991
[6] See Southworth and Klemm, 1985
[7] See Klemm, 1990
[8] See AAAS, 1989
[9] See Young and Pottenger, 1986
[10] See Young, 1986
[11] See O'Shea, Kimmel and Novemsky, 1990
[12] See Gullickson-Morfitt, 1991
[13] See Hiltz & Turoff, 1978
[14] See Hiltz, 1981
[15] See Hiltz and Kerr, 1982
[16] See Hiltz, 1988
[17] See Katz Maxwell & others, 1987
[18] See Kerr, 1983
[19] See Southworth, et al., 1990.
[20] See Uvarov and Prusakova, 1990
[21] See Southworth, Petrov, and Goto, 1991

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David L. Moore is Director of Technology with the Sanger Independent School District in Sanger, Texas, USA. There he has been involved with all aspects of technology: computers, telecommunications, and computer curriculum. He is a Master Trainer with the Texas Educational Network, Apple Computer Educator, and Texas Computer Education Association Computer Adminstrator of the Year (1990-91). He has worked closely with Telecommunications and Informatics Laboratory at the Texas Center for Educational Technology to bring multimedia educational telecommunications to the Sanger schools. He has become a regular educational user of the UH PEACESAT system via the ATS-3 satellite.

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Basic Telecommunications Needs Model:
A Methodology for Assessing Information and Communication Poverty

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The research for this paper was commissioned by the Telecom Australia Consumer Council (TACC) and funded by Telecom Australia

Abstract

The expressions 'information rich' and 'information poor' are now commonplace in the telecommunications research lexicon. Managers, policymakers and community agencies, however, do not have comprehensive conceptual and methodological tools at their disposal to identify information and communication needs and the 'information poor'. This paper attempts to address some of these concerns. A model and methods for investigating information and communication poverty are proposed.

> There is, in essence, no sociology of telecommunications which has generated understanding of users and their uses to which regulators can assign value (Dervin & Shields 1990: 4).

Despite a large body of literature on information and communication needs there remains an absence of persuasive evidence about those needs or how to identify those needs. Existing studies have failed to assist managers, policymakers and consumer groups because researchers have tended to impose their own definitions of 'needs' upon the people they were studying (Dervin & Shields, 1990). The methodology proposed in this paper draws on the social theory of Hindess (1988) and the constructivist approach of Balnaves and Caputi (in press) and on participatory approaches to the study of information and communication needs. The first part of the paper provides a background to information and communication needs research. The second part of the paper outlines the concept of basic or common information and communication needs. The third section of the paper presents a theoretical model and methods relevant to the assessment of those needs. The final section of the paper outlines preliminary results from a pilot study.

Information and Communication Needs Research

It is beyond the scope of this paper to conduct a general survey of all the works on information and communication needs. Dervin and Nilan (1986) and Kunz, Rittel and Schwuchow (1976) have conducted detailed reviews of the literature on conceptual and methodological issues of information need. A review of the literature by Williamson (1984) suggests that there is no agreement on what constitutes an information or communication need or how one should proceed to develop uniform methods for assessment of such needs (see also, Crane, 1971; Crawford, 1978; Dunn, Noble & Peguillan, 1977; Horne, 1979; Leupolt,1983; Lin & Garvey, 1972; Lipetz, 1970; Martyn, 1974; Voos, 1969; Wilson, 1981; Wood, 1969). There are definitional problems for both information and need. Faibisoff and Ely (1978) noted that a review of thirty-nine definitions of information science included only eight definitions of 'information' and that no element was common to even two of these. Numerous definitions have evolved. Attempts have been made to distinguish between 'data' and 'information' (see, for example, Maguire, Lovelace & Kench, 1976), and between 'knowledge' and 'information' (see, for example, Childers, 1975; King & Palmour, 1981).

The general research focus in studies of information and communication needs has not been 'user-oriented'. As Dervin and Nilan (1986) pointed out, most of the approaches have been constrained by definitions of what needs are and they have been limited to examining behaviour primarily within user intersections with systems: 'In fact, it could be said that the needs of interest are system needs not user needs' (p.11). Earlier researchers asked respondents to name problems or questions for which information had been needed (see, for example, Macbeth & Hitchens, 1977; Warner *et al.*, 1973; Williamson, 1977). Dervin *et al.* (1976) were critical of such studies, concluding that the word 'information' may well constrain individuals to name concerns that they believe can be dealt with in the confines of existing information systems, the very systems citizens indicate that they rarely use.

While not directly addressing the above issues, the work of Tinker (1989), Claisse and Rowe (1987), Cooper (1987), Moyal (1989) and others indicate that the starting point in a study of information and communication needs is the *forms of thought* or *specialised techniques* available to people or to groups in the conduct of the business of daily life. 'Most of the specialized tools used in academic work, for example, make use of the relatively commonplace skills of reading and writing. Within a society individuals and groups may differ in the specialized tools they are able to use or are in a position to acquire' (Hindess, 1988, p.97). Those who miss out on more commonplace tools, like literacy, may be severely disadvantaged when it comes to the use or acquisition of other techniques. For example, Claisse and Rowe (1987) have pointed out that the telephone is a 'management tool of daily life' and that 'special habits' have attached themselves to telecommunications usage. The acquisition of these special habits has consequences for the acquisition of others. It is also the case that not everybody will be equally placed to benefit from the efficiencies gained in use of space and time or the kinds of specialised techniques that have become associated with telecommunications and computers. Similarly, not everybody will be able to acquire the kinds of skills that those technologies require.

Telecommunications may also promote skills in social support, as Moyal (1989) has shown in analysis of the feminine culture of the telephone. Aronson (1971) used the expression 'telephone neighbourhoods' or 'psychological neighbourhoods' to describe such networks. A network might consist 'of a group of elderly widows living alone

who maintain scheduled daily telephone contacts as a means of ensuring the safety, health, and emotional security of the group's member' (p.162).

Skills and techniques that develop around telecommunications usage, whether they are related to solving problems, answering questions or promoting social support, are legitimate areas for investigation. It would also seem that information and communication needs are conceptually tied to these skills and techniques or, more appropriately, to what Derr (1983) has called 'information purposes'. Derr argued that the concepts 'information' and 'purpose' are intimately related. He said that there is a distinction between 'information want' and 'information need'. An information want involves aspects of knowing where the person concerned has no *legitimate* purpose. For example, a person might want information about a neighbour's activities out of idle curiosity, but that is not sufficient for saying that the person needs that information. Conversely, lacking information is not a sufficient condition for saying it is needed. Many physicians recommend an annual physical examination for persons forty years of age or older. A ten-year old may not be familiar with the physician's recommendation but such lack 'is not sufficient for our saying that it is needed' (Derr, 1983, p.273). An 'information need' requires a legitimate purpose. If a person was middle aged, we would say that she needed the information regarding the physician's recommendation regardless of whether she wanted it or not. 'Information need' refers to a relationship which obtains between information and the information purposes of individuals: 'It is an objective condition rather than a psychological state' (Derr, 1983, p.276).

The idea of information purpose is also related to the notion of *being informed* (Balnaves, 1990). As Jonas (1953) has suggested, people are purposeful beings and in order to be purposeful they must be 'in-formation' (p.192). However, it is necessary to distinguish between the *means of becoming informed*, such as information and communication technology, and *being informed*, which is a characteristic of individuals and groups.

Information and Communication 'Commons'

In Australia, consumer groups and community agencies have actively developed a model of 'social equity as equality'. This model incorporates the idea of identifying the information and communication 'commons' of Australian citizens with the idea of social equity (Balnaves & Richardson, 1990). The model also suggests that a distinction should be made between individual needs and individual circumstances and *basic* telecommunications needs. Individual circumstances such as physical or social disabilities may affect a person or a group's capacity to meet basic telecommunications needs. For example, a low-income, elderly and disabled person who has eyesight difficulty might require additional attachments to the phone in order to make a phone call. The ability to make a call may be termed basic, but the individual circumstances in this case deny the person access to the phone, firstly because they may not be able to afford attachments to remedy the access problem and, secondly, because they do not have the physical wherewithal to use the phone (Balnaves & Richardson, 1990). Basic telecommunications needs, however, are those needs which are common to all of us. We might call *access* to the traditional telephone, for example, a basic telecommunications need because so many information and communication purposes are dependent upon it. Similarly, there may be a level of telecommunications *usage* that is common to all of us. Cooper (1987), for instance, identified three telephone calls a day as essential.

However, there is no empirical evidence about common information and communication purposes and basic telecommunications needs. It might be the case that the traditional phone and three calls a day are not sufficient to meet basic telecommunications needs. Policymakers at present do not have the conceptual and methodological tools necessary for identifying common information and communication purposes and basic telecommunications needs.

Individual and Collective Needs

The evaluative notion of 'telecommunications needs' or 'information and communication needs' suggested in this paper draws from both prescriptive and consensual approaches to social policy. Firstly, *there are individual differences in needs*. For example, the elderly and disabled or rural residents will have different needs from those in urban areas. Secondly, *there are also collective similarities in need and in the acquisition of specialised techniques related to telecommunications*. The ability of all people to answer questions efficiently and cheaply may be called a collective need or a common information purpose. For example, PRESTEL, the British version of videotext, embodies large economies of scale. The more answers the user obtains, the lower the cost per answer. Indeed, costs could become negative. This situation occurs for subscribers of consumer reports or other product testing magazines when the savings that users obtain from product-test details in the magazine exceed the cost of a subscription (Maynes, 1983).

Maynes' (1983) work suggests that it is possible to identify *gains* or *losses* involved in meeting or not meeting information and communication needs. There may be *monetary losses* incurred by people or businesses who pay more than necessary for meeting telecommunications needs. There may be losses incurred by people or businesses obtaining *less than was needed* to meet telecommunications needs. There may also be losses from the fact that people or businesses were *unable to discern*, and hence purchase, the price-quality combination best satisfying telecommunications needs. For example, an elderly person who cannot afford to obtain answers to everyday life questions in the most efficient manner may be at a disadvantage compared with another who can. A person with access to an efficient videotext system (which PRESTEL was not), as mentioned earlier, can gain economies of scale.

Information and Communication Poverty

There would appear to be four aspects of any definition of information and communication poverty. The first aspect of definition suggests that the concepts 'information' and 'communication' are related to the concepts *being informed* and *being associated* . The second aspect of definition suggests that telecommunications have an obvious relationship to *conducting the business of everyday life*. The third aspect suggests that losses might be incurred in not meeting information and communications needs. Losses might occur because of insufficient resources, like income, or because some portion of a resource, for example, income, is absorbed in other useful or wasteful ways. Losses might also occur because of inaccessibility to particular technologies . Lack of access might occur because of corporate reasons (the provider is incapable of delivering the technology); physical reasons (an individual is incapable of using the technology); psychological reasons (an individual

is unwilling to accept alternatives or does not know that particular choices are available); or intellectual reasons (an individual does not have the knowledge necessary to use the technology). The final aspect of definition of information and communication poverty would suggest that there are common information and communication purposes. The purpose of the authors' research is to identify the *commonality of these needs.*

A Telecommunications Needs Model

It is possible to suggest five components of a theoretical model for assessing information and communication needs. Firstly, there are those situations or *sites* in which telecommunications might be required. The authors will refer to these as Domestic or Business Sites (S). A site might be a family household, but it might also be a corporation such as Telecom or a plumbing business which uses mobile phones. The concept of site, therefore, can be applied to a nomadic aboriginal tribe, whereas the concept of 'household' cannot. Sites are defined by the kinds of relationships involved and the kinds of specialised techniques and forms of thought employed in those sites. Secondly, there is the ability to conduct the business of everyday life. Everyday Life Activities (ELA) have been the primary focus of urban information needs studies which have identified topics such as neighbourhood, consumer, housing and maintenance, employment, education and schooling, transportation, recreation and culture, financial matters, public assistance, discrimination, health, legal, crime and safety (Chen & Hernon, 1981). Thirdly, there are common aspects to everyday life activities which are dependent upon information and communication purposes (P), that is, *being informed* and *being associated.* Fourthly, while citizens have information and communication purposes, the technologies themselves *serve a purpose.* Thus, the characteristics of the technologies (T) must be part of any assessment of information and communication needs. These technologies may be relatively simple, such as the traditional phone, or more complex services such as Personal Communication Networks. Finally, these technologies, in turn, enable efficiencies to be gained in use of space and time (E). Telecommunications technologies allow people to save time and travel, for example, in making appointments at a hairdresser or in contacting an employer for a job.

The proposed model contains all the elements that one would find in a situation where a person wanted to become informed or to participate in the business of daily life. These elements would form the basis of any development and assessment of a methodology used to investigate information and communication needs. A methodology which addressed both the psychological and sociological dimensions of information and communication needs in the sense discussed above, including the gains and losses incurred in not meeting those needs, would provide policymakers with an index of information and communication poverty.

An Index of Information and Communication Poverty

The authors have suggested that it is possible to identify gains and losses entailed in meeting information and communication needs and that these gains and losses are real in their consequences. Five methods (community profiles, diaries and focussed interviews, substitution matrices, repertory grids and community organisation) are proposed to investigate these gains and losses, in the context of the model presented above.

Community Profiles are profiles of sites and the demographic circumstances in which individuals or groups live. A profile includes understanding the discursive conditions (specialised techniques and forms of thought) available to individuals or groups. For example, Balnaves and Caputi (in press) have combined the personal constructivist approach of Kelly (1955) and the social theoretic approach of Hindess (1988) to develop a detailed notion of both 'personal' and 'corporate' constructs and sites. Hindess argued that a capacity to make decisions is an integral part of anything that might be called an actor. State agencies, political parties, football clubs, churches and tenants' associations are all examples of actors in the minimal sense. 'They all have means of reaching decisions and of acting on at least some of them' (p.46). The actions of a tenants' association, a corporate site, is of course, always dependent upon the actions of others such as managers, elected officers, employees and other organisations. Hindess argued that there are actors other than human individuals, 'some of whom play an important part in the modern world, but that classes and societies are not among them' (p.47). His concern was with the identifiable means of making decisions, which may include, among others, specialised forms of analysis and techniques such as Aristotelean physics, ritual, mythology, and writing systems. The concept of sites and community profiles advanced in this paper builds on the work of Hindess and others. The kinds of questions people pose for themselves and the conclusions they reach will often depend on the forms of thought or specialised techniques available to them. The expression 'corporate constructs' will be used to refer to such techniques (see Balnaves & Caputi (in press) for a more detailed discussion). They are corporate in the sense that they are the product of numerous individuals. A corporate actor, like a football club, is dependent on corporate constructs like accounting techniques, management techniques, leadership techniques, and so on, and on the individuals *using* such techniques.

Diaries and Focussed Interviews, at the individual level, enables people to record their information and communication purposes whether or not they have telecommunications services. If individuals have a telephone, then incoming and outgoing telecommunications calls would be recorded. The diaries are simply a record of the frequency and nature of information and communication purposes.

The *Substitution Matrix*, a technique developed by the authors, allows individuals to indicate the extent to which information and communication purposes could have been carried out in any other way, that is, could be *substituted.* These matrices will indicate the degree to which people perceive telecommunications to be essential to their lives. Personal constructs can also be derived from the matrices and used in repertory grids (Kelly, 1955).

The application of *Repertory Grids* (Kelly, 1955) to the study of information and communication needs is new. A grid allows a researcher to see how one idea (for example, a perception of telecommunications technology) has linkages with other ideas, and how one form of telecommunications technology (for example, the mobile phone) is perceived as similar to, yet different from other forms of technology. The grids may be used to examine different psychological dimensions of information and communication purposes in the context of traditional and future telecommunications technologies and to derive data on perceptions of acceptability of different forms of communications, such as perceptions of flexibility, speed, and degree of privacy and

efficiency. This approach will indicate which groups are likely to adopt innovative technologies and which groups are likely to be resistant to change. It is envisaged that the notion of 'corporate construct' will be included in the grid methodology, but this work is still in its developmental stages in the pilot work conducted by the authors.

Community Organisation enables community participation in definition of its needs. One of the important aspects of the methodology proposed in this paper includes participation by individuals, consumer groups and community agencies in the research process itself. Organisations such as the Telecom Australia Consumer Council (TACC) are ready made means of community organisation. With empirical evidence about information and communication needs, associations like the TACC will have knowledge necessary to assess the competence or efficiency of different organisational forms and their component parts (for example, judging the actions of Telecom itself and other agencies involved in the definition of Community Service Obligations, such as AUSTEL, and private businesses). The issue of competency is also relevant to the problem of constructing a wider political system that allows representation of interests that may be either poorly organised or without the power to lobby from positions of prestige or possession of resources (Hirst, 1986) (for a discussion on community organisation see also Brager, Sprecht & Torczyner, 1987; Kramer & Sprecht, 1983; Musick & Hooyman, 1976; Stein, 1986)

Incorporation of both corporate and personal constructs into Hindess and Kellyan theory and the use of repertory grids in the analysis of information and communication needs represents a major conceptual and methodological advance in communication theory. The substitution matrices are also new techniques. Community organisation complements a methodological approach which is user-centred and relational in character. The methods do not simply involve taking a snapshot of a person's situation and subsequently deriving a list of needs. Rather, the methods try to capture the dynamic nature of how people meet their information and communication needs and to indicate the gains and losses that might be incurred if those needs are, or are not, met.

At what point can one say that we have discovered common information and communication needs? To answer this question it is worthwhile providing a brief hypothetical description of how some of the methods work.

Let us start with a personal and a community profile. Consider a disabled seventy-five-year-old social security pensioner; no private transport; own house in the outer western suburbs of Melbourne; belongs to local bowls club; veterans association; local church group; living alone; no tertiary education; no other major assets; Anglo-Saxon; previous employment boiler-maker; wife dead; contacts with close relatives. Public transport system (trains and buses) is available; local health centre; no local library; industry intensive suburb; median income under $35,000 (and so on). These are demographic characteristics in the community profile.

Diaries would be given to the pensioner to record incoming and outgoing telecommunications activities (or in the absence of telecommunications, incoming and outgoing information and communication purposes). The substitution matrix would elicit which purposes were considered essential and which could not be substituted by any other means. For example, the pensioner has a traditional telephone and records a purpose as 'using the phone to make banking transactions'. He notes that this purpose cannot be substituted because of his disability. He finds it difficult to walk to the bank to conduct his banking business. In this case the traditional phone appears to be essential to mobility. However, the personal construct 'mobility-rigidity' comparing the traditional phone with a cordless phone and a mobile phone may be presented to the pensioner for further analysis. When considering the construct, the pensioner might state that the traditional phone is in fact a restriction on mobility when compared with other technologies. For example, the pensioner may find it difficult to walk from one room to the next where the traditional phone is located. Such a difficulty may be overcome were a cordless or a mobile phone is available. Further prompting highlights that the pensioner has developed *strategies* of coping with the traditional phone and these strategies may be dependent on factors in the *domestic site*.

The pensioner may not have been aware of the existence of alternative technologies such as mobile phones (cf Tinker's 1989 findings). The pensioner's lack of knowledge about alternative telecommunications might be related to 'corporate constructs', such as literacy, which affect acquisition of such knowledge, restricting the ability to become informed. Of course, corporate constructs may also be responsible for resistance to change. The grid itself would have provided knowledge about alternative technologies and highlighted what the pensioner then perceived to be a *loss* in mobility, that is to say, when the utility of the traditional phone was compared with that of alternative technologies the pensioner perceived the traditional phone to be less useful or in fact 'rigid'. What the pensioner reveals is that it is not the traditional phone that is essential or necessary, but rather the strategies for compensating for lack of mobility. Indeed, there would be an increase in 'efficiency' if the pensioner were to have a cordless or mobile phone. This example illustrates the operation of substitution matrices and repertory grids and, to some extent, corporate constructs.

Let us now compare the pensioner with a twenty-five-year-old young professional in a different domestic site. The twenty-five-year-old may rate the construct 'mobility-rigidity' differently, for example, she may think that the cordless phone also lacks mobility, given that it can only be used in a range of 50 metres. In terms of their everyday life activities, both the pensioner and the young professional have *similar* information and communication purposes, for example, the need to do banking. The difference between the young person and the pensioner is that the young person can substitute walking to the bank for using the telephone, whereas the pensioner cannot. The point here is that for the pensioner the mobility is a far more important factor, even though the 25-year old perceives the traditional telephone to be 'rigid'.

The repertory grid and the substitution matrix provide a personal subjective point of view in usage of telecommunications, or any other service and activity in the community. However, there is also an *objective, corporate point of view*, that may suggest limitations to any personal strategies which are employed in particular situations. This last point needs further clarification. Literacy in this case is a *corporate construct* (a specialised technique). The pensioner, if illiterate, may argue that 'I don't necessarily need to be literate to survive in Australian society. I can develop strategies to overcome most, if not all, the difficulties associated with being illiterate'. The answer highlights some of the limitations associated with a subjective point of view. There are consequences involved in being illiterate that *personal construal* does not adequately address. For

example, there may be, potentially, loss of income, loss of job, restrictions on social life, and so on. In this case the pensioner may find it difficult to find out about alternative technologies let alone how to use them.

The purpose of the methods is to enable researchers to assess information and communication needs and to derive an index of information and communication poverty. The concept of basic or common telecommunications needs (BTN) is based on the relationships between the five components of the telecommunications needs model (S, ELA, P, T and E).

The index derived from the model and the methods indicates gains and losses incurred by individuals in the absence or presence of certain telecommunications technologies. These losses or gains may be: (i) tangible, such as gains in efficiency; or, (ii) psychological or social nature, such as maintaining or improving support networks.

Pilot Study

The model and methods proposed in this study make possible the development of a framework which provides a clear conceptual understanding of 'basic telecommunications needs' and the development of a methodology which measures those needs in both a qualitative and a quantitative sense. The methodology has as its starting point an analysis of 'information' and 'communication needs'.

A pilot study to test the model and methods took place over a period of six weeks during July and August 1991 in conjuction with preliminary fieldwork on the information-seeking behaviour of older adults conducted by a doctoral student. Older adults were chosen as the target group because numbers are growing rapidly in Australia, as in all developed countries of the world. A comparison of the older adults with two younger people was included in the study.

Sample (and Site) Details

Ten older adults, some very frail and living in special accommodation, others robust, active and living in their own homes, were chosen for the pilot study. The ages of the two males and eight females ranged from 60 to 92, four between 60-69 years of age, four between 70-79 and two between 80 and 92. Snowball sampling, a nonprobability technique, was used to develop a network of representative contacts. Other than the three in the special accommodation, who were hand-picked by the supervisor, all participants were personally known to the researchers. Half were well educated - to diploma or degree level. Former careers included accountacy, teaching, engineering, secretarial/clerical. Four were pensioners and six non-pensioners. Two had quite severe disabilities (diabetes and heart conditions). Whilst we do not believe the participants are necessarily typical of their age groups, we believe that we needed to use alert and competent participants for the pilot. The two younger participants were both aged 20, university students and living with their parents.

In order to gain an understanding of present telecommunications use and knowledge, participants were asked about the telecommunications equipment used in their homes and about the types of equipment they know are presently available or soon to be available. Seven (including the two young people) had only one conventional phone; one had a push button phone; two had both a conventional phone and a push button phone with memory; one had a push button phone with memory and a FAX machine. This last respondent, an engineer, still works part time as a consultant. He estimated that 10 per cent of his telecommunications use is for business purposes.

Knowledge of present and future availability of telecommunications equipment varied. Resopndents had at least heard of cordless and mobile phones and FAX machines, although most had never used them. Some of the older women participants said they were wary of all new machines and could not imagine using a FAX machine. The two older men indicated the best knowledge of present equipment available (better than that of the younger people), although even they seemed unaware of new developments in the field (for example, digital systems which allow more than one call to be taken on a line).

Procedure

Diaries (one for incoming and one for outgoing calls) were delivered to each participant in early July. Participants were given personal briefings on how the diaries should be kept over the two-week period required. At the end of the recording period the diaries were collected and analysed in preparation for the interviews, which began about a week after the diaries were collected.

The interviews tooks an average of two hours (minimum one-and-a-half hours; maximum three-and-a-half hours). Each of the BTN instruments was tested, along with those to be used for the doctoral student's research. We took the approach that with such a complicated piece of research which is using such a wide range of instruments, adjustments should be made if considered necessary during the pilot. Where problems arose during the trials, changes were made or clarifications were provided as soon as consultation could take place amongst members of the team.

Diaries

There was wide variation in the number of calls made and received by participants over the two-week period. The minimum number of calls made was three, the maximum 56. For incoming calls the minimum was five, the maximum 46. Table 1 presents the number of calls for each participant.

TABLE 1
Number of Calls Made and Received by Participants

Person	Outgoing*		Incoming*	
	Local	STD	Local	STD
		Older Adults		
1	13	-	22	-
2	10	1	5	3 (+1ISD)
3	13	8	12	3
3 (FAX)	2	2(ISD)	-	3(ISD)
4	11	-	7	2
5	10	1	10	2
6	14	-	15	3 (+1ISD)
7	20	-	17	-
8	8	2	13	1
9	3	-	5	-
10	56	8	46	10
		Young People		
11	33	-	30	1
12	15	-	10	-

*Includes only successful calls plus the first attempt at a call which was never made (because number was engaged or did not answer).

Respondents were asked to note the purpose or the purposes of each call made. Both outgoing and incoming calls fell into the following categories:

Family network: Calls to or from family members, where family contact and support were involved. Some of these calls were also included in other categories; for example, recreation, business and investment.

Social network: Calls to or from friends and neighbours, where social contact and support were involved. Calls in this category were also often included in other categories, for example, recreation, health.

Voluntary services provided by participants: Included such activities as working bees, assisting family members with voluntary labour. Sometimes these services were related to particular professional expertise, for example, a teacher of shorthand providing an appropriate entry for an Australian dictionary. Arrangements for babysitting grandchildren were included in 'family network' calls.

Investment or business related: Included matters related to the maintenance of income, for example, maintenance on properties rented to tenants.

Services sought, offered to, or received by participants or by their family or friends: Most calls involved the seeking of services by participants, for example taxi services, services from chemists, furniture removalists, banks, libraries. Older adults with mobility problems particularly used the phone to request services.

Paid employment: both the younger participants and two of the older adults were involved in part-time paid employment and amde or received calls associated with this.

Recreation: Included theatre and restaurant bookings as well as participation in clubs and sporting arrangements (often also recorded in 'family network' or 'social network'), but not private social functions which were coded in the social network category only.

Travel: Included holiday as well as everyday travel, for example, booking a hire car for a holiday.

Health: Most calls were inquiries about family members and friends who were ill and are also recorded in 'family network' and 'social network' categories. One call was to a professional for health information. Calls to make doctors' appointments are recorded in the 'services sought' category.

Legal: Most calls were discussions of legal issues with family members. Two of the older adults have family members who are solicitors.

Continuing education: Calls concerned courses in which some of the older adults were interested.

Concessions: The one calls made concerned the over-60s card.

Table 2 sets out the above purposes together with the numbers of outgoing and incoming calls made with those purposes.

TABLE 2
Purposes of Calls Made or Received

Purpose	Outgoing		Incoming	
	Older	Young	Older	Young
Family network	51	1	77	2
Social network	47	44	60	36
Voluntary services	7	-	15	-
Investment or business	11	-	8	-
Services sought, offered to or received	43	-	6	1
Paid employment	6 (+3 fax)	3	4 (+ 3 fax)	2
Recreation	20 (+ 1 fax)	1	17	-
Travel	2	-	3	-
Health	17	-	8	-
Legal	2	-	5	-
Continuing education	1	-	2	-
Concesssions	1	-	-	-
Other	1	-	1	-

From Table 2 it can be seen that, for older adults, the largest number of calls were to or from family members. While calls to or from friends (the social network) were the next largest category, outgoing calls regarding services were almost as numerous. It seems that older adults, especially those with limited mobility, are very dependent on the phone for obtaining services. Purposes such as the organisation of recreation, the discussion of investments and business and the provision of voluntary services emerged strongly for older adults, although many of the calls involved were made to family or friends. Clearly there was often an overlap between information and communication needs. The tendency for people to rely on information providers who are psychologically most accessible appears to be confimed (Wilson, 1977; Chen & Hernon, 1982; Williamson, 1984).

The purposes for which the young people used the phone were, in some ways, in stark contrast to those of the older adults. The young people used the phone almost solely for social purposes (although one cannot rely on a sample of two). It will be interesting to see if these trends are confirmed in the next stage of the research.

Substitution Matrices

In an attempt to gauge the importance of the telephone for each of the outgoing calls recorded in the diaries, a substitution matrix was used. Participants were asked if there were any other ways they could have achieved the purpose or purposes they had in mind.

Although the administration proved a very repetitive exercise, especially for the participant with 56 outgoing calls, the substitution matrix appears to be a very useful instrument. From it we gained insight into each person's philosophy or rationale of telephone use, together with some indication of the degree of need involved. The usefulness should be enhanced when we further develop the instrument for collection of data on individuals and sites.

While participants seldom saw satisfactory alternatives to the telephone for fulfilling the purposes recorded in their diaries,

some participants used the telephone more sparingly than others. One of the young participants said that she visited people in preference to ringing because she had no privacy at home. On the other hand, the other young participant used the phone regularly and made more than twice as many calls as the other young person. One of the older adults, the participant with the FAX machine, said that he always had in mind the economics of alternative methods of communication. Others, particularly those in special accommodation and those without a car, had fewer alternatives to consider.

The possible alternatives which participants frequently mentioned were personal visits and letters. The former were mostly dismissed because, in the circumstances, they were considered to be inconvenient, time consuming and expensive. Distance was frequently mentioned. Participants also sometimes saw a phone call as a way of avoiding more pesonal intrusion. Letters were mostly considered to be too slow as a form of communication. The lack of immediate response was also emphasised. Several participants mentioned that it is not possible to discuss things by letter.

It was from the substitution matrices that most of the constructs for the repertory grids emerged.

Repertory Grids

The use of grid techniques in the study of information and communication needs enables the researcher to explore individual differences and collective similarities among perceptions of telecommunications technologies. The nature of these differences and similarities may highlight psychological gains and losses associated wiht the use or absence of these technologies.

A repertory grid was administered to twelve participants. Each grid consisted of eight elements and eight constructs.The elements listed across the top of the grid included Conventional Phone, Cordless Phone, Mobile Phone, Personal Visit, Letter by Post, Hand Delivered Letter, FAX and Lettergram. The constructs listed at the side of the grid in bi-polar form included Written-Oral, Personal-Impersonal, Direct-Indirect, Cheap-Expensive, Private-Public, Convenient-Inconvenient, Fast-Slow, Acceptable-Unacceptable. The bi-polar constructs were derived from the substitution matrices and represent the way participants construe the similarities and differences of the forms of communications. Participants were asked to rate each construct on a five point scale. For example, one of the participants, 'Margot', rated the conventional phone '2' along the construct 'personal-impersonal', indicating that to her the conventional phone is a personal mode of communication.

Of the twelve repertory grids, only three had common constructs and elements. It is the commonalities among these three grids that we will examine here. The three grids were compared using multidimensional scaling, a common technique for analysing multiple repertory grids. The elements and constructs were represented jointly in the solution. The multidimensional scaling solution is a best-fitting representation of how elements and constructs relate to each other.

Several constructs and elements grouped together. For example, the three elements conventional phone, cordless phone and mobile phone clustered together, that is to say, all three participants viewed these forms of communication in a similar way. These three elements were located close to the pole 'oral' of the construct written-oral, an obvious interpretation is that the three participants in the study viewed the phone as an oral communication medium.

The elements FAX and lettergram also formed a cluster. This cluster was located close to the constructs personal-impersonal, fast-slow and direct-indirect in the solution. In general, communications via FAX and lettergram were perceived by the participants as fast, but also impersonal in nature. Interestingly, personal visits and hand delivered letters were seen to be acceptable, convenient and direct means of communication, whereas FAX and lettergrams were not. Telephone technologies were, in comparison, construed as acceptable.

One implication of these repertory grids for telecommunications managers is the possibility that FAX technologies have failed to be seen as relevant and acceptable among the elderly. It is important to note, however, that the results presented here are constrained by sample size and difficulties that some participants had in interpreting constructs. These difficulties are themselves useful in developing further the application of repertory grids to various audiences.

What is missing in this presentation of the repertory grids is the relationship between the personal constructs and corporate constructs of the domestic site. Some aspects of that relationship were discussed in the body of the text.

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ORGANIZATION RESTRUCTURING: FITTING A STRATEGIC FRAMEWORK

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ABSTRACT

The challenge of integrating a telecommunications company's home base with its worldwide operation can be met with a strategic framework. Elements of a framework include a shared mission, values, priorities, business focus, financial objectives and an appropriate organizational structure. Factors driving organization structure include customer needs, regulatory requirements and culture of the firm. The strategic framework of NYNEX will be reviewed as a model.

In the past, most telecommunications enterprises organized and managed on a functional basis to effect internal efficiencies. Those were less volatile times. However, in our home market in the Northeastern part of the United States, we today have technology and regulatory change bringing ever increasing competition. Moreover, the recessionary economy along with maturing markets has lowered growth rates to low single digit numbers. On the other hand, the lure of high growth opportunities in countries outside the United States has spurred development efforts to make investments in new markets where we can use our core competencies.

To manage this changing environment and effect the desired results in its home territory and overseas investments, a telecommunications enterprise must have a strong foundation. This foundation must provide the support and direction for its people both at home and abroad.

MISSION

First, an enterprise's foundation needs -- more than ever -- a clear mission with a core set of values. At NYNEX, we have a clear mission to be:

A World-Class Leader in Helping People to Communicate Using Information Networks and Services

A world-class leader sustains excellence over time in those markets in which it chooses to compete. Helping people means our customers will always be people, not computers talking to computers, but people using computers to talk to other people. We are a service business sensitive to human needs and responsive to people.

VALUES/PRIORITIES

The foundation on which all of our businesses stands is a common set of values and priorities.

NYNEX's core set of values is followed by all its companies and people, i.e., quality, ethics and caring for the individual.

We have been reneving our commitment to quality and making it an integral part of how we meet the requirements of our customers. Each year our Chairman recognizes individuals or groups with a special Chairman's Award for Quality.

We have renewed our commitment to ethical business conduct. Along with the establishment of an Office of Ethics and Business Conduct, we have a strong code of business conduct which our people know and follow.

We have renewed our commitment to caring for the individual. We have established a dialogue with our employees and other stakeholders such as regulators, legislators, community leaders and the media, and we are working to strengthen those relationships and the trust necessary for our success. One outcome of this improved dialogue with employees is the early signing of our labor contracts well before their expiration dates.

All of our businesses worldwide follow one set of priorities, i.e., customer satisfaction, cost competitiveness, earnings growth and employee empowerment. These priorities are the keys to our success in all our activities.

Customer satisfaction depends on a dialogue with our customers. We expect all of our businesses to continually survey their customers and respond to survey findings.

Cost competitiveness is absolutely necessary in today's competitive environment given the rapid changes in technology and regulation. We require all of our business units to gather industry data and perform benchmarking studies on an annual basis.

Earnings growth creates the funding and confidence necessary for further growth.

Employee empowerment reflects a trust in our people to "do the right thing". This, coupled with the quality process, is a powerful force for change at NYNEX.

LINES OF BUSINESS

NYNEX has defined and is focusing on four key lines of business through which we serve our customers, apply our core competencies and create value for our shareholders. Moreover, in any market and in any country we choose to enter, we intend to be the best in these businesses. They are:

Building and operating wireline networks. This area covers our activities in privatizations of telecommunications companies, building value-added networks, global networks and CATV. These businesses are built off our core telecommunications competencies from our home region.

Building and operating wireless networks. In this business, cellular networks remain our primary focus in our home territory and in our worldwide activities. Other related wireless networks services also fall in this business area.

Data base management and information delivery. In this area, we manage large data bases of telephone subscribers for our Yellow pages advertising business. In addition, we manage our clients' customer data bases in our direct marketing and telemarketing businesses.

Information systems consulting, development, operations and software services. The development and operation of information systems is a core competency of NYNEX. This is reflected in the wide array of companies to service our customers worldwide.

FINANCIAL

The overall financial goal of our enterprise is to create and enhance shareowner value, both in the short and long term. While in the past, we have done much to enter new businesses to effect higher earnings growth, our present objective is to create greater value from our existing businesses.

At NYNEX, our business development process began in 1984 when we were divested from AT&T. Over the past eight years, we have worked hard to establish material businesses in each of our lines of business. We developed these business both through acquisition and through internal growth. The price of our business development activities during the start up phase was earnings dilution. Today, our objective is to manage growth and create a steady increase in shareholder value.

By following our priorities - customer satisfaction, cost competitiveness, earnings growth and employee empowerment - in each of the markets we serve and in all of our businesses, we have a common worldwide mechanism for creating and enhancing shareowner value.

ORGANIZATION

NYNEX has organized itself into two major business groups, i.e., the Telecommunications Group and the Worldwide Services Group. This organizational formation was driven by both business and regulatory considerations.

The Telecommunications group is responsible for New York Telephone Company and New England Telephone Company, both located in our home territory in the Northeastern part of the United States. Our remaining businesses fall within our Worldwide Services Group. Companies in this Group operate both in our home territory and in markets throughout the world.

In earlier times, we had relied on teamwork to build synergistic relationships among all our companies. With the creation of the two Groups, we are able to bring a more concentrated business focus between specific companies in closely related businesses, as well as provide common leadership.

Moreover, we are also able to alleviate any regulatory concerns arising from close relationships between the regulated and unregulated parts of our business.

SUMMARY

As the worldwide telecommunications industry continues its rapid change, we can expect NYNEX's organization structure to respond to these new challenges. We expect that these challenges will cause changes within each of the Groups, but changes in NYNEX's overall corporate structure will be much slower.

Our mission, values and priorities will remain a constant guide for our people at NYNEX.

MAINTAINING SUBSCRIBER LOYALTY DURING DEREGULATION

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1. ABSTRACT

As PTT's face deregulation, liberalization of services, privatization, and the threat of competition, the importance of preparing the subscriber base so as to minimize the impact on future revenues and profits increases. Opening up lines of communication with the customer base before these changes occur is the key to success.

2. INTRODUCTION

Change. The word can bring fear into the heart of the bravest manager. But it can also open the doors to new opportunities for success for those who know how to manage it. As telephone administrations face the forced changes brought about by privatization, liberalization and deregulation, which interpretation of the word "change" will apply? Will competition mean lost customers or stronger service? Does deregulation threaten or challenge employees? Will regulators and politicians be seen as enemies or friends?

To a great extent, the answers to those questions lie in management's ability to properly communicate the effects of new policies even before they happen. Countries throughout the world are experiencing or planning for structural and regulatory changes in the way monopoly services like telecommunications are provided. Some governments hope to realize lump sum gains from selling off these assets; others hope introducing competition will improve service and lower costs for the general public. There are many stages of progress in implementing these ideas, and much value can be gained by learning from the experiences of those who have taken one approach or another.

At GTE, for example, the changes in U.S. regulations have had a tremendous effect. The Customer Premise Equipment market has seen competitors come and go, and GTE has had to develop innovative network services to offset competition and meet customer needs. At GTE's Hawaiian Tel subsidiary, the only U.S. local exchange company permitted to carry international long distance traffic, market share plummeted when toll competition was introduced, and a long hard battle ensued to win it back. GTE's subsidiary in the Northern Marianas, Micronesian Tel, also had to deal with competition in the long distance market, while at the same time adjusting to operating under new foreign ownership.

Being among the first to have to face these changes, these companies had to develop innovative programs and strategies to maintain customer loyalty, while at the same time restructuring their profit base. Again, the key to success in each of these cases was implementing a clear communications strategy to a variety of audiences.

3. THE FOUR "W's" OF COMMUNICATING CHANGE

WHY does change need at be communicated at all? WHO needs to know? WHAT needs to be said? WHEN is the right time? All these questions must be considered in developing a communications strategy.

3.1 Why?

There are many reasons why a strategy needs to be developed and implemented. One of the most basic is that "if you don't, someone else will!" Being first with the information that is presented is critical to maintaining that influential position expected of the incumbent organization. The administration that everyone has dealt with and is familiar with has the built-in advantage of credibility. The information coming from this source should be the most

trusted. Giving that power up to a competitor, regulator or even the press puts the administration in a defensive position. Maintaining control over the content and timing of what goes out is essential to achieving objectives.

Often these types of changes require the administration to incur new costs as networks are upgraded, salesforces are built up, and new services are introduced. Preparing the public for rate restructuring that often accompanies these investments is another important reason why a strategy is needed.

An administration facing these issues is also liable to have a very anxious workforce. The grapevine runs rampant in times of change, and unless clear, timely information is coming from the company, this can lead to incorrect rumors circulating, valuable employees leaving, and a reduction in productivity. Any chance of attracting new employees is also weakened if the administration becomes perceived as a "bad place to work."

Maintaining a competitive edge, preparing the rate base for future investments, attracting and keeping employees-- some or all of these reasons may apply to each local situation and need to be considered in developing a communications plan.

3.2 Who?

It's tempting to think one piece of information can get wide distribution and answer everyone's questions. Unfortunately, an administration has many "audiences" for what it has to say, and each of them will interpret the same message differently. For example, a communication that talks about plans to revitalize the bottom line with new investments and streamlined operations will excite potential investors but may totally offend the general public who feel they have to pay for it and worry employees panicked about job security.

The answer then is to segment all the possible groups and come up with a communications strategy for each. Examples of these audiences include: residential customers and the general public, business customers, employees, regulators and politicians, investors, and the press. If appropriate, these can be broken down into even smaller groups, i.e., large businesses vs. small companies.

Once the audiences are identified, their specific needs can be analyzed, and the proper messages and programs can be developed to make sure these people get the information they need to maintain their confidence in the administration and feel comfortable about the changes ahead.

3.3 What?

There are a few general messages and some very specific ones that need to be sent to the target audiences. During any regulatory change, the bottom line of what people are going to want to know is "how will it affect me and my pocketbook?" And again, the answer is going to be different for everyone. To a marketing employee who will see increased commissions from new sales, change could mean an improved salary, but for those employees in an operating area trying to control expenses, it could mean cutbacks or a lower raise next year. Customers may have to pay higher rates for some services, yet see benefits from new products and higher quality of existing services. The administration must prepare each message carefully to highlight the benefits to the target audience and downplay any adversities. Learning from the experiences in other countries and sharing this information locally can assist in allaying fears and emphasizing the positive side of change.

The audiences are segmented, their requirements are identified, and the messages are prepared. The next step is to determine the right vehicles to spread the word. These could include press releases and bill inserts to reach the general public, face-to-face meetings and handouts for employees or executive interviews in the business press. Getting employees up to speed on the issues and positive about the effects of upcoming changes is an important part of any strategy. Employee confidence carries to friends and family who look to them as "telecommunications experts." Employees can also be an effective resource as a Speakers Bureau. Training the good public speakers and making them available for community meetings and events multiplies the number of people who can spread the right word.

Not all communications should be one-way however. The organization which is most successful at managing change is the one that LISTENS as well as speaks. Feedback from each

of the audiences must be obtained to help adjust ongoing communications and determine which messages are successful. Customers and employees especially need ways to express their concerns, get quick answers and find reassurance. Some methods that can be used include surveys, suggestion boxes, customer panels and "hotline" numbers to call.

Finally, all suggestions must be recognized, and action has to be taken. Responsiveness gives the administration credibility and builds trust and loyalty more than anything else.

3.4 When?

Should the new regulations be announced before this process starts? Does the first news editorial have to appear before a reply is drafted? Do enough employees have to quit to make executives recognize they have a problem? The answer to all these questions is NO. And the answers to "When does a communications plan need to be developed?" and "When should messages go out?" are IT'S NEVER TOO EARLY and IT'S NEVER TOO OFTEN.
Start now!

4. Micronesian Tel Experience

GTE Hawaiian Tel's subsidiary in the Commonwealth of the Northern Mariana Islands (CNMI) is a good case study of how to apply these techniques to a company in flux.

4.1 Situation

In the late Seventies, the islands of Saipan, Rota and Tinian were on the verge of unprecedented economic growth. Tourism was beginning to boom, and the infrastructure needed to support this expansion was sorely lacking. The local telecommunications operation was having trouble keeping up with demand for basic service, let alone meeting the more sophisticated requirements of expanding businesses. GTE Hawaiian Tel (HTC) purchased the company in 1981 and began a huge capital expansion that continues to this day. Facilities were completely overhauled, and by 1986 a new digital system was in place. Today, Micronesian Telecommunications Corporation (MTC) has two gateway switches, underground cable, two new earth stations, and microwave radio systems.

But ten years ago, HTC and MTC had a lot more than service and technical problems to fix. For one thing, there was an image problem. It wasn't that MTC had a bad image--even worse, it had no image at all! People thought of it as the "silent" phone company, and took it for granted as they struggled to deal with its bureaucracy and uneven service. Employees came and went. There was little training or incentive to stay, so turnover was extremely high. Also, both employees and subscribers alike were concerned about having foreign investors and worried about the changes that could occur. As if this weren't enough to deal with, competition in the equipment and international toll markets began in the mid-eighties.

4.2 Communications Strategies

Weighing all these factors, the management at both HTC and MTC gathered to work out a communications plan designed to overcome the fears of the public, instill enthusiasm in employees and give businesses confidence in the improvements to come.

The messages they selected to communicate included:

- MTC was dedicated to becoming a quality, full service provider
- Foreign investors were not "taking over" to threaten the work environment
- There were growth opportunities for additional local employment
- Competition would benefit subscribers bringing new services and lower prices
- MTC would need capital to make improvements

Each of these was then tailored to various audiences, and the best methods to get them across were implemented.

4.2.1 Residential Communications

For residential customers and the general public, the main theme that was communicated was *"MTC has people you know bringing you more efficient service."* It was important to emphasize that local employees were still going to be around, and that, once trained, they would be the ones to make improvements happen. One of

the most effective ways MTC got this message across was to use their own employees in new television and print advertising. A corporate video was also made that showed MTC people in their work environments. Company officials took every opportunity they could to give newspaper interviews about the changes to come and praise the experiences in Hawaii that would be used as a model and transferred to Saipan. To get immediate feedback, a customer suggestion box was installed in the main office, and subscribers were encouraged to give their comments.

4.2.2 Business Communications

Business customers were hoping for improved service and "one stop shopping." Unlike residents, they didn't particularly care whether local people were involved; they just wanted results. MTC sent out a strong message that said *"We are going to be your quality, full service provider."* This was preached at Rotary Club meetings, delivered through the Chamber of Commerce, printed in business publications, and even discussed at face to face meetings between MTC officials and their largest customers.

4.2.3 Employee Communications

One of the most important yet most difficult audiences that had to be reached was current employees. Job security had been a fact of life, and change was particularly threatening. There was little pressure to get the job done, and often extra services weren't charged to keep subscribers happy. This had caused spiraling expenses and resulted in a lackadaisical workforce. MTC's message, then was twofold: *"We care about you and want to help you develop. We all have a stake in the bottom line."*

The first step in getting the message across was to hold a series of individual work group meetings and explain how the company made money. The emphasis was on how revenues were collected and how employees' time was translated into expense dollars. This set the stage for getting employees' input on how to improve the financial picture, and Employee Involvement groups were formed to develop suggestions. MTC selected an outstanding employee who was interested in furthering her education and sponsored her to attend a university in Hawaii. This also sent a strong message to the rest of the group that MTC was serious about investing in its people. A special annual kick-off event was planned to provide some excitement and give management another forum to emphasize the benefits of change. Then once employee attitudes were changed, they were encouraged to participate in community events and help spread the word. MTC sponsored a beach clean-up that made employees feel good about their company while at the same time impressing the local community with the dedication and commitment of MTC employees to improving their home.

4.2.4 Government Communications

Local politicians and government regulators were asked to *"Invest in our efficiency."* Their concerns about losing local employment opportunities were allayed, and the benefits of community involvement were seen in the employees' activities. This group needed a lot of one-on-one communication, and senior management was called upon to make sure the proper meetings were held.

4.2.5 Media Communications

Last, but not least, MTC made a concerted effort to get the press on its side. *"You'll be the first to know"* was clearly demonstrated in both speech and practice. They were invited to all product announcements and ceremonies dedicating new facilities. A press release on the planned network expansion was given wide distribution, and key employees were made available for interviews on future investments. The press was even invited to the annual employee kick-offs so they would feel like "one of the team."

4.3 Results

These and many other programs contributed to the success MTC has experienced over the last ten years. It has gone from a sleepy little company with 2200 subscribers and a waiting list of 1500 in 1981 to a state-of-the-art corporation serving over 10,000 customers. Employee turnover has been reduced, and MTC enjoys excellent relations with the press and government regulators. MTC's CPE business continues to grow at a solid rate, and international long distance is highly profitable. This was accomplished by delivering on promised actions and successfully meeting communications goals:

- prepare the public for new investments
- keep good employees and attract new ones
- demonstrate the benefits of change

5.0 GTE Hawaiian Tel Experience

MTC's parent company, GTE Hawaiian Tel, was successful in Saipan because it had already faced many of the same problems by going through deregulation in Hawaii. A lot of the lessons learned were applied to the situation in the CNMI, and thus problems were avoided.

Hawaii felt the full brunt of the break-up of the U.S. telecommunications empires. After the regulatory dust settled, GTE Hawaiian Tel found itself in the unusual position of maintaining its monopoly in local service, being prohibited from offering long distance between Hawaii and the Mainland U.S., but able to freely compete with its international toll business. Equipment was fully deregulated, and competition in both toll and equipment was fierce. Other pressures were being forced upon the Company as well. Prices had to be rebalanced, and major rate cases had to be brought before the Public Utilities Commission. Expenses had to be streamlined to compete more effectively, and employees were being shuffled around. Some positions were even eliminated.

HTC went through the same planning as discussed for MTC, but came up with some unique programs that were right for the larger market of the State of Hawaii.

5.1 Public Programs

For many years, Hawaiian Tel had been taking a monthly survey of residential customers to get feedback on its sales and service activities. Facing all these changes, it was now time to take more aggressive action to correct the problems that were being identified and let people know of improvements. HTC set up a new department reporting directly to the President of the company called Consumer Affairs and chartered it to take whatever action was needed to improve customer communications. A "hotline" was installed for the public to call whenever they weren't satisfied with the response they were getting by going through normal channels. The hotline staff was committed to getting an answer back to the customer immediately. An interesting side note to this program is that what started out as a complaint center eventually became a way for customers to call and say thank you, compliment specific employees and make suggestions. The company was seeing positive benefits already!

HTC also wanted more specific feedback during change. To achieve this, a customer panel made up of residential and small business people was formed who met with different company officials once a quarter and gave their opinion on new products and services. HTC could also learn how the general public felt about issues by talking with this group and getting their reaction.

5.2 Business Programs

Similar programs were implemented for the business market as for the residential customers. A separate survey was taken each month for larger businesses, and a panel just for business customers and their specific issues met separately from the consumer panel. HTC realized that these customers, who accounted for the bulk of revenues and were the most vulnerable to competition, needed special handling.

Service became the differentiating strategy. Service Advocates were identified from the operations groups and assigned to the forty largest customers. These people were called for expedited attention in case of a problem, and they also met regularly with their customers to develop service plans to meet forecasted growth. Executives were "assigned" to the large accounts too to strengthen business relationships between HTC and the business community. Smaller customers were served by yet another program called the Small Business Advocate. Here lower level supervisors volunteered to visit each of Hawaii's 10,000 small businesses and ask for feedback on how the quality of service could be improved. Customers were impressed with all these quality improvement programs, and HTC's image became synonymous with service.

5.3 Employee Programs

As always, employees comprised one of the most important audiences to address. HTC concentrated on

developing plans and programs that would alleviate employee concerns and encourage them to be proactive participants in implementing improvements. Employee involvement was introduced not just as a fancy buzzword, but as a way of life. A process was put in place to ensure employees with ideas and suggestions had the ability to get themselves heard and action taken. A detailed survey was taken that encouraged feedback on a wide range of subjects, including pay levels, recognition, communications, and benefits. Resulting action plans started at the top, with senior management's compensation based on how well they were implemented.

Management was encouraged to get out of their offices and keep in touch with the day-to-day business. "Breakfast with the Boss" and skip level meetings helped cut through the chain of command and ensure the messages of change were delivered straight from the top all the way through the ranks. These and many other programs got employees involved early on in the process of change. Once a feeling of trust was developed, it was much easier to deliver news, both good and bad.

5.4 Community Programs

The employees in turn were then used as excellent spokespeople within the community. Volunteers spoke at local meetings, organized community work days and helped out at various events and activities-- all in the name of HTC. Through its Volunteer Initiatives Program, the company even made funds available for employees to support community programs in which they were personally involved.

Since much of the new competition was from the U.S. mainland, HTC developed a media strategy to reinforce its local image. Television commercials with Hawaiian music and ocean scenery reminded the public of HTC's roots, and when HTC's 100th anniversary rolled around, the company developed a year-long celebration that further emphasized its longevity and solidity.

As a result of all of these programs, GTE Hawaiian Tel is a very different company today than it was prior to deregulation in 1983. It has managed to adjust to the changing telecommunications environment and emerge as a financially healthy corporation with a quality service image.

6.0 Summary

There are many fast decisions which have to be made during a period of change, and it's tempting to overlook the importance of taking the time to tell customers and employees alike what they are and why they were made. However, lack of communication up front means a big price to pay later on. Disgruntled customers look to competitors, investors move on to other opportunities, and valued employees leave. A simple communications strategy implemented in a timely manner can prevent loss of business during deregulation and maintain loyalty from both the public and employees.

Empirical Measurement of Strategic Telecommunications Linkages with Customers, Suppliers, and Business Partners

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1. ABSTRACT

This paper reports on the results of a survey of U.S. and European corporations to examine and measure interorganizational linkages between the firm, its suppliers, its customers and other business partners. Strategic telecommunications linkages were measured according to the number of megabytes being transmitted and the amount of time these linkages have been operational. In addition, examination is made of *which* functions of the organization are responsible for the linkages by looking at the role of purchasing & manufacturing; marketing & sales; distribution & service; and research & development. The data is broken out for each of these categories. The three types of critical strategic linkages studied are firm-to-customer, firm-to-supplier, and firm-to-business partner.

2. INTRODUCTION

This report is based on the results of a June 1990 survey mailed to several thousand corporations, primarily in North America. Approximately 60 responses were received, including surveys returned and in-depth telephone interviews with telecommunications managers. The survey covered a wide range of telecommunications issues.

3. THE CHANGING ROLE OF TELECOMMUNICATIONS IN THE FIRM

There are three major forces of change facing the telecommunications professional. First of all, there is rapid change in the general avilability of services which might be purchased for the firm. Second, the underlying hardware and software systems being made available is increasing the number of options for configuring networks. Finally, the nature of general business strategy is changing so that the telecommunications function, which has heretofore has played a primarily internal role in the firm is now being asked to implement networks on the exterior of the firm as it interlinks with its environment. These three forces of change are producing an unprecendented amount of turmoil in the role of the telecommunications manager.

Telecommunications may provide the critical linkages which tie together different parts of today's firm as it moves towards heavier use of computerization in its business activities. More and more information workers spend their days in front of computer display terminals, communicating not only with their local data processing facilities, but with workers at many different geographic locations. From long-distance, even international, networks to campus and local area networks, telecommunications is the corporate nervous system making it possible to automate almost all major functions in the bureaucratic infrastructure of today's firm.

It is now no longer necessary to contenplate having different duplicate databases located in several locations. Now, a single large relational database can be accessed through the telecommunications system. Some major multinational corporations are presently consolidating their data centers into regional "mega centers", and this is driven at least in part by new possibilities in telecommunications. There are reported cases of firms consolidating their entire worldwide operations into single "global" data centers.(1)

The *scope* of automation is increasing as well, because the growing number of linkages make it possible to merge even more applications into clusters of automation. With each new wave of investment, data processing is pulling together more and more critical business processes and tying them together through telecommunications-based linkages of computer systems.

3.1. THE EMERGING ROLE OF STRATEGIC LINKAGES

We have seen over this last decade the beginning of a movement towards formation of strategic linkages. The idea for these linkages began in the early 1980's, when a few companies placed computer terminals in

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PERCENT OF STRATEGIC LINKAGES WITH SUPPLIERS, CUSTOMERS AND BUSINESS PARTNERS REPORTED BY DIFFERENT FUNCTIONAL AREAS

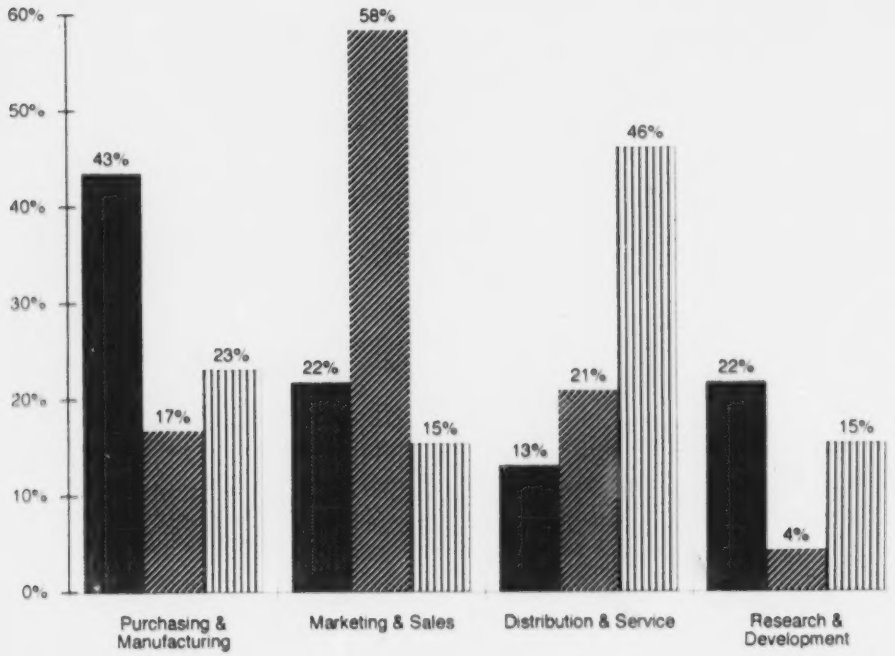

Figure 1

the offices of their customers, but it has taken until the end of the decade before we find that the practice is becoming widespread. Strategic linkages with suppliers, customers, and even business partners are ushering in an entirely new role for telecommunications.

Strategic linkages are based on the general theory of the value added chain as applied to the automation of various informational transactions throughout the business process. The firm is viewed as being a processor of inputs into outputs and the value of the outputs minus the value of the inputs is the value added of the business process under consideration. Although in Europe, the value added tax (VAT) has been a common method of taxation for years, the concept of the value added chain has been slow to take hold in North America. The value added chain model links the firm, its suppliers and customers.(2)

As applied to telecommunications, value added chain theory is associated with building networks to move commercial information between the firm, its suppliers and its customers. For example, home banking systems in which the customers link into the the bank through using a telecommunications linkage, is an example of a *forward* value added chain linkage. For just-in-time inventory control in the manufacturing process, telecommunications-based linkages with suppliers is an example of a *backward* value added chain linkage. According to the theory, once a firm builds telecommunications-based linkages along the value added chain, it is more difficult for competitors to break into the business since the firms will have to bear the extra expense of switching to a new relationship.(3) This "information bonding" erects switching costs which act as a barrier to entry against competitors.

In addition to supplier and customer linkages, a third class of telecommunications-based strategies has grown up: interorganizational systems with business partners.(4) These are telecommunications-based arrangements in which all basic trade documentation is telecommunicated from firm to firm through a shared network. EDI is just one example of an entire class of phenomena in this area. The result should be a general acceleration of the bureaucratic processes associated with trade and manufacturing.

4. METHODOLOGY

This study is based on survey of telecommunications managers in large corporations located primarily in the United States. Although several surveys were sent to companies located in Europe, the overall pattern of the European responses was not significantly different so as to be able to change the results. The survey responses were followed up with telephone interviews in which additional information was gained. The research process lasted approximately 9 months during 1990.

4.1. IDENTIFICATION OF SAMPLE

The study started with a large mailing list of MIS and telecommunications managers located in both large (Fortune 500) and medium-sized corporations throughout the United States. From this list, a random sample of approximately 3,000 companies was selected to receive the survey. Before mailing, this list was checked to ensure that it represented a reasonable cross-section of different types of industries. The result was a list which represented a large cross section of business in the United States.

In Western Europe, the same survey was mailed in France, West Germany, The United Kingdom, and Holland. Mailings in Europe were considerably smaller than in the United States.

4.2. QUESTIONS ON THE SURVEY INSTRUMENT

Data Collection Form Used

LINKAGES TO YOUR **SUPPLIERS**	Purchasing and Manufacturing	Marketing and Sales	Distribution and Service
Business Functions Linked Together			
M-bytes Trans/Month	M-Bytes	M-Bytes	M-Bytes
Linkages Operational How long?	Months	Months	Months
LINKAGES TO YOUR **CUSTOMERS**	Purchasing and Manufacturing	Marketing and Sales	Distribution and Service
Business Functions Linked Together			
M-bytes Trans/Month	M-Bytes	M-Bytes	M-Bytes
Linkages Operational How long?	Months	Months	Months
LINKAGES TO YOUR **STRATEGIC ALLIANCE PARTNERS**	Purchasing and Manufacturing	Marketing and Sales	Distribution and Service
Indicate the type of strategic alliance and company involved			
Business Functions Linked Together			
M-bytes Trans/Month	M-Bytes	M-Bytes	M-Bytes
Linkages Operational How long?	Months	Months	Months

The survey was mailed during the spring and summer of 1990. In some cases, the survey was delivered via facsimile, but these cases were small in number.
As the surveys were returned, the data was organized into two major groups: service companies and manufacturing.

4.3. TELEPHONE INTERVIEWS

Two separate sets of telephone interviews were conducted: Set 1 to follow-up on the survey questionnaires which had been returned; Set 2 to compile case studies of telecommunications planning.

Set 1: Since the returned survey instruments were frequently incomplete, follow-up telephone interviews were conducted to verify the data which had been supplied and also to collect even more information regarding the specific challenges being faced by the various telecommunications organizations.

Set 2: In the second series of telephone interviews, a list of telecommunications managers sampled randomly from a list of the 100 largest telecommunications customers of AT&T was used to make contact. After the telephone interview, we followed up by sending them a copy via facsimile of the survey questionnaire.

Strategic Linkages with Suppliers, Customers and Business Partners

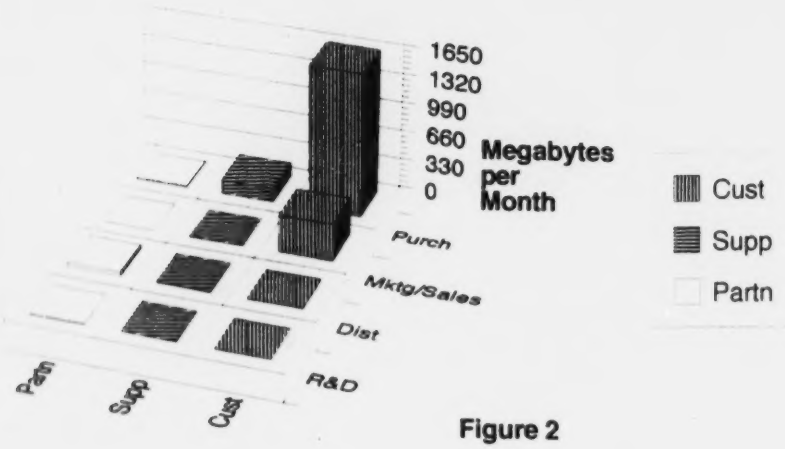

Figure 2

4.4. VERIFICATION OF DATA

The telephone interviews were used to verify the answers which had been returned with the survey questionnaire instrument. This was an important exercise, as there were many minor changes in the data which were required.

In addition, in those cases where the response appeared to be too far out of the expected range, the answers were checked again with the respondee and verified. If the out-of-range number was in fact the case, then the telephone interviewer probed to get some additional insight into how the number came about. This was a most useful exercise in understanding the situation being studied.

4.5. ANALYSIS OF OVERALL RESULTS

After the empirical data had been put together, the general trade press was surveyed to confirm the overall trends which were appearing. In addition, we concentrated on correlating to the fullest extent possible the statistical picture we were receiving against the reality of what we were learning from the case studies.

A reasonableness check was performed on all of the data by matching the conculsions carefully with what different consultants have been experiencing in various assignments. This helped confirm the general trends, and improve the general validity of the conclusions drawn here.

5. STRATEGIC TELECOMMUNICATIONS LINKAGES WITH SUPPLIERS, CUSTOMERS AND BUSINESS PARTNERS

The variety of strategic linkages made between the firm and its customers, suppliers and business partners can be distinguished according to the busines function which is responsible for initiating or managing the linkage.

The data suggests that all three types of linkages are being used perhaps more widely than we would have estimated in the absence of data. However, different functions within the firm are "specialized" in different linkages. Purchasing and manufacturing has the greatest amount of linkages with its suppliers, as one might expect. Marketing and sales has the vast bulk of its linkages going to the customer base, and the distribution and service functions are responsible for most of the inter-organizational linkages. (See Figure 1)

This type of specialization makes sense in light of the respective responsibilities of the different functions involved.

6. STRATEGIC TELECOMMUNICATIONS LINKAGES -- TRAFFIC VOLUME

Measurement of the volume of data being telecommunicated over these linkages yields a slightly different picture. The data shows that although each of the four major functional areas of the firm are maintaining some level of strategic link-

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STRATEGIC LINKAGES -- NUMBER OF MONTHS OPERATIONAL

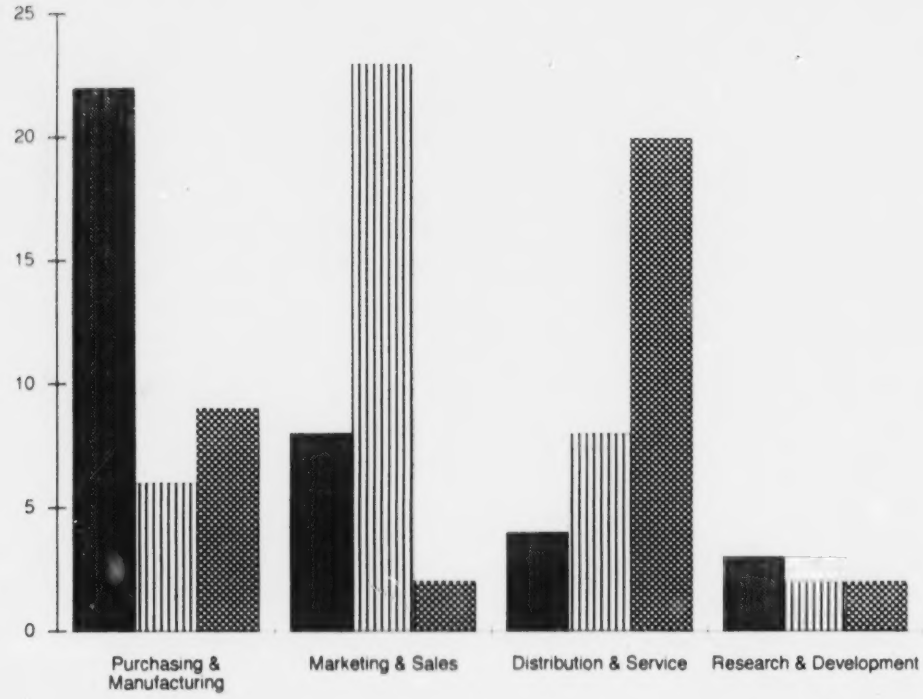

Figure 3

ages, the purchasing and manufacturing function and its linkages to customers represent the greatest volume of transactions by a very great margin. The second greatest category of volume transmission is from the marketing and sales function to the customer base. In terms of the total amount of information being transmitted through these strategic linkages, fully 90% is to the customer. (See Figure 2)

This would suggest that investment in other types of strategic linkages are not as well developed at this point and can benefit from further investment in the future.

7. STRATEGIC TELECOMMUNICATIONS LINKAGES -- HOW LONG HAVE THEY BEEN OPERATIONAL?

An hypothesis that strategic linkages are still in the development stage is supported by the data which examines how long they have been in effect. The data shows that on average companies appear to have strategic linkages which are only approximately 2 years old, for the most mature and widely used linkages; and considerably younger for the other types of linkages under consideration.

Megabytes per Month	Purch & Manuf	Mktg & Sales	Dist & Svce	R & D
To Suppliers	157	1	10	2
To Customers	1,655	426	3	0
To Bus Part	13	1	40	0

The research and development function appears to be at the lowest point in the learning curve for this development; but the other functional areas each appear to be working on exploitation of the technology. (See Figure 3)

8. CONCLUSION: THE NEED FOR "RELATIONSHIP MANAGEMENT" ON THE PART OF TELECOMMUNICATIONS

The key management challenges for the 1990's involve better "relationship management" on the part of telecommunications as it deals with the information systems function, with line management steering committees in the firm, and with parties outside the firm involved in telecommunications-based strategic linkages. The new technologies available, as well as many factors external to the firm (i.e. increased competition), tend to put considerably more pressure against the telecommunications executive. It is a changing picture in which old assumptions about roles and successful behavior patterns must change.

There are several types of relationships which must be managed *simultaneously* in order to effectively create the best telecommunications environment for the firm. The relationship with the information systems function is critical in this effort. Building strategic linkages along the value added chain requires much more teaming than in the past to ensure that telecommunications supports the strategic mission of the firm.

Another area of relationship management concerns the connections which the telecommuncations function may have with organizations *outside* of its own firm. Particularly in the realm of strategic linkages, the telecommunications function is inevitably responsible for keeping the linkages up and running at all times. In most cases, these are critical activities. Due to the very high importance of these linkages, the telecommunications function must emphasize prudent and careful management.

In building alliances with outsiders, the telecommunications function may become the only "face" that others see from the firm. This may in some cases be a considerably higher and more visible profile than the telecommunications function has been accustomed to in the past.

9. NOTES

1 See the case of Manufacturer's Hanover Trust Company in Roche, Edward M. Managing Information Technology in Multinational Corporations (New York: Macmillan Publishing Company, 1992).

2 See the model in Porter, Michael. Competitive Advantage (New York: Free Press, 1985).

3 See McFarlan, F. Warren. "Information Technology Changes the Way You Compete." Harvard Business Review (May-June 1984) and Porter, Michael. "How Information Can Help You Compete." Harvard Business Review (August-September 1985).

4 See Barrett, Stephanie S. "Strategic Alternatives and Interorganizational System Implementations: An Overview." Journal of Management Information Systems (Winter 1986-1987) and Johnston, Russell, and Michael R. Vitale. "Creating Competitive Advantage with Interorganizational Information Systems" MIS Quarterly (June 1988).

LEGAL AND REGULATORY ASPECTS OF MEDIA INTEGRATION

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Presented at the Pacific Telecommunications Conference
Honolulu, Hawaii, January 1992

ABSTRACT:

As more and more of the world's telecommunications are carried in digital form, regulators, carriers, and end users will face a host of new challenges. In a digital environment, the concept of services -- video, voice, data, etc. -- is no longer meaningful. Rather, all services become binary "bits" in data streams, and carriers become the providers of pipelines for these bitstreams. Because there is no way to distinguish a video bit from a voice bit or a data bit, it will be increasingly difficult for regulators to distinguish video from voice or data services, or to control the content of information transmitted over digital networks. One likely result is more competition, with attendant benefits for telecommunications users.

The transition to an all-digital telecommunications operating environment has important implications for how telecommunications are offered and regulated. This paper explores some of the implications, distinguishing today's services-based model of telecommunications regulation from the emerging "pipeline" model. The paper discusses those legal and regulatory approaches best suited for the dynamism of the current environment and contains a case study of the global satellite marketplace, where many of the legal and regulatory issues involved in digitization have come into sharp focus.

I. THE SERVICES-BASED MODEL

In most countries today, telecommunications are offered and purchased within specific service categories. If one wants to make ordinary telephone calls, he obtains a voice-grade line from the telephone company. While this line may be used for certain kinds of data services -- including particularly facsimile services and computer modem communications -- the line is not intended for data and does not provide the kind of reliability that is typically demanded in data networks.

If a company has major data communications needs, it does not purchase voice lines from the telephone company. Rather, it will purchase special data services, which allow it to send data at speeds considerably faster than it could over conventional voice lines, and with significantly better bit error rates. Similarly, if a company wishes to transmit video, it would typically purchase video services from the communications provider, rather than attempting to make video signals work properly over an ordinary telephone line.

There are many variations on these three (voice, data, and video) themes. For example, Comsat's tariff for U.S. services via Intelsat satellites lists five kinds of voice grade services, some six video alternatives, and four digital services. Within each of these options, the user must make choices regarding such matters as bandwidth, data speed, preemptibility, and term.

From a user's perspective, the availability of so many service alternatives is both good news and bad news. The good news is that most of these services evolved as a result of specific user requests, and hence their availability represents responsiveness on the part of major telecommunications providers, including the governmental and quasi-governmental administrations that dominate global telecommunications. The days are gone when, as AT&T used to be quoted as saying in the United States, you could have any color of telephone you wanted, so long as it were black.

The bad news is that the wide variety of service choices can be confusing, and the distinctions are often arbitrary. In some countries, data sent over leased "private lines" is regulated differently from data sent over "public" networks, even though the same facilities may be used in both cases. And if the service offerings are sometimes more clear, the pricing may not be. Without lawyers, accountants, and other experts -- luxuries that generally can be afforded only by larger users -- it is difficult for the businessman to evaluate which service alternatives best meet his needs.

In terms of legal and contractual relationships, the services-based model plainly advantages the service provider/carrier, rather than the user. The carrier understands its tariffs and is able to tailor service offerings in a manner intended to maximize returns from the carrier's capital investment in a network. When the carrier negotiates with the user, the carrier does so based on its own tariff, and the user generally

has little ability to affect price or offering terms. Even today, when the largest telephone companies are paying more attention than ever to customer responsiveness, and when "custom tariff" deals can be negotiated, the notion of "user friendly" services is still more a matter of public relations hype than it is telecommunications reality.

Governmental regulators, like service providers, find themselves advantaged by the services-based model. In many nations, of course, there is effectively no distinction between the governmental regulator and the telecommunications service provider, although there is a worldwide trend toward separating regulatory and communications provision functions. Even where regulatory functions are separated, there is an advantage for the regulator in dealing with discrete services, because the government may wish to subject different forms of service to different regulatory regimes. Thus, for example, several nations have insisted on maintaining their monopoly over voice services, while allowing a more deregulated, competitive approach to data services. Similarly, for cultural and trade-related reasons, nations may want to exclude certain video programming from other nations, while encouraging for commercial reasons full cross-border information flow with respect to voice and data.

The services-based approach often leads to maintaining telecommunications rates at artificially high levels, thereby discouraging use of the network and assuring inefficient use of plant. For example, prohibitions on resale are common in many tariffs, as part of how services are defined; while nominally intended to "protect" the small user, these prohibitions effectively raise prices, and at the same time prevent the efficiencies that are realized when users are able to share excess capacity. Tariff restrictions relating to connection to the network (except when rigorously justified on technical grounds) similarly do not advance goals relating to the needs of users or the efficient use of the network.

The separation of telecommunications into various services with complicated tariffs thus facilitates economic and technological inefficiencies, while giving regulators more "handles" onto which they may grasp in their efforts to achieve certain social and policy goals. These goals, however, are fundamentally unrelated to telecommunications functions, which can best be achieved when the regulators loosen their grip on, or let go of, many of the handles. It is also the case that, regardless of efficiency considerations or policy goals, governments throughout the world are going to be forced to release more and more of the handles, as digital technologies become dominant in global telecommunications.

II. THE PIPELINE MODEL

To understand the regulatory transition to a digital environment, it is helpful to think of telecommunications in terms of a grouping of pipes, rather than a grouping of services. Just as would be the case in a municipal water system, the pipes are of various sizes and have different technical qualities, with larger pipes going down main arteries and smaller pipes branching off to individual businesses and homes. As with the water system, moreover, the substance flowing through these telecommunications pipes is in all cases essentially the same: the digital bits that make up the essence of modern communications.

To continue the metaphor, different nations, and even different areas of the same nation (especially urban vs. rural areas), are in quite different stages of development with respect to this key component of infrastructure. Some are still using the communications equivalent of the backyard well, while others are in the process of laying fiber -- fundamental to any serious digital system -- to every home and business. Obviously, the nations with more backward systems will have strong incentives to modernize, or to encourage private industry to do so, in order to remain competitive in the global economy.

The legal and regulatory implications of the transition from a services-based model to a pipeline model are enormous, and are only just beginning to be understood. From a contractual standpoint, in terms of the relationship between the service provider and the user, the advantage in the pipeline model goes to the user. The bargaining is not over confusing service options, carried out in the context of a tariff dictated by the service provider, but rather is based simply on determining which characteristics of the pipe (e.g., size, transmission medium, bit error rate) are most important to the user, and how much the user is willing to pay for them. Because the pipes providing telecommunications are often fungible, moreover, the user is in a position to shop around for the best deal, assuming that the regulatory authorities will allow competition.

Regardless of whether telecommunications pipelines are offered monopolistically or competitively, there will be an increasing need in the future for providers of value-added services and equipment. As more countries are recognizing, it is advantageous to encourage vigorous competition in these areas, because such competition leads to more use of the basic network. Only the largest users have the in-house sophistication necessary to take advantage of the flexibility offered by digital pipelines. For smaller users, intermediaries in the form of value-added service providers and equipment vendors are vital, serving to make modern digital communications accessible to all.

This accessibility, however, is dependent on the pipelines being available, and at reasonable

prices. Neither availability nor reasonable pricing can be assured in the absence of competition in basic services. In a monopoly administration, where a single provider makes the infrastructure investment decisions, and where pricing of the pipeline is typically well above cost, value-added networks ("VANs") are not likely to flourish, and telecommunications modernization will be slowed as a result. There is thus a direct and inescapable relationship between a nation's encouragement of VANs and its willingness to allow competition in the provision of communications pipelines.

As telecommunications comes to be seen in terms of pipelines, rather than services, and as digitization and media integration become commonplace around the globe, regulatory authorities will have little choice but to allow more competition. When users are purchasing undifferentiated pipes, it becomes difficult, and often impossible, to determine what kinds of traffic are being carried over networks. Digital voice, data, and video simply cannot be distinguished, and regulatory structures based on such distinctions will look increasingly anachronistic. As the pace of digitization accelerates, moreover, complicated communications service categories, and the government bureaucracies necessary to keep track of those categories, will no longer be justifiable, and many of the non-telecommunications goals served by regulation will not be capable of achievement.

Government might still be able to maintain a monopoly provider of the basic pipeline, but it is reasonable to ask why government would wish to do so. When telecommunications is viewed as a relatively fungible commodity -- a stream of bits proceeding down a pipe -- there would seem to be little justification for monopoly treatment. Why should other commodities be sold in competitive markets, while data bitstreams are restricted to monopoly provision?

One answer commonly given is that there is a public interest in a universal, ubiquitous telecommunications infrastructure, serving rich and poor, urban and rural areas alike. Competition, the argument goes, leads to "cream-skimming," with the heavy traffic areas well served while the "thin routes" are not served at all. This argument, of course, is simply one for cross-subsidization -- i.e., charging higher rates in some areas in order to underwrite service to other areas.

In fact, however, subsidization is going to become increasingly difficult to sustain, as digital networks encourage (and make virtually undetectable) bypass of public switched facilities -- particularly if the rates for public facilities are kept artificially high. Thus, for example, a government that has determined to deregulate all areas except switched voice may quickly find that its proclamations are essentially being ignored by at least the larger, more sophisticated users, who will have no difficulty mixing voice and data over their digital pipelines, and who will have strong incentives to do so. Any private line that terminates at a PBX instantly becomes a means of entry into the public network, bypassing elaborate regulatory mechanisms and remaining all but undetectable to the regulators. Similarly, while video program control may be maintained at the consumer level (e.g., through broadcast and cable television regulation), there will be substantial quantities of video material that will enter the country as digital information (e.g., via satellite) that cannot easily be controlled by government.

If social goals relating to rural infrastructure are to be achieved, such goals should be addressed directly (e.g., through taxes or user fees), rather than in ways that distort use of the network and create other inefficiencies. It is also the case that competitive markets respond to user needs, even in thin route situations, developing creative technological solutions in the absence of massive government subsidies. For example, rural telephone networks are increasingly being implemented based on satellite and radio communications, rather than on the highly inefficient stringing of telephone lines to remote areas.

Trends unrelated to digital technology, including especially the globalization of trade and the breaking down of national barriers, should help to accelerate the movement toward competitive digital networks. In a Europe in which, within a few years, national boundaries may be relevant solely for linguistic and historical purposes, it will no longer be acceptable for national telecommunications administrations to impose differing service definitions and differing technical standards for interconnection to the public network. Instead, Europe is moving toward diverse and competitive digital networks, with open architecture accessible to a wide range of equipment vendors and enhanced service providers.

Digital technology and the move toward media integration will impact dramatically on the legal and regulatory structures of telecommunications that have been built up over the past century. Some governments will undoubtedly resist the forces of change, and insist for years to come on maintaining monopoly administrations focused on outdated concepts of voice, video, and data services. Ultimately, however, economic development will be retarded in those nations that resist too strenuously, and even the holdouts will come to embrace the reality of digital pipelines and the accompanying advantages of competition.

III. THE COMMUNICATIONS SATELLITE MARKETPLACE: A CASE STUDY

Developments in digital communications are typically associated with developments in fiber optics, because the fiber optic medium is

entirely digital. If satellites are thought of at all in this context, it is almost as an afterthought -- i.e., satellites too can provide digital communications. In fact, satellites are increasingly part of digital networks, being used not only for data services, but also for digitized video (particularly when compression of signals is a factor) and digitized voice.

The media integration trends discussed in the preceding sections raise interesting regulatory issues in the context of satellites. Satellite communications are inherently difficult for regulators to control; satellites cover wide areas and do not respect national boundaries. Thus, for example, a homeowner with a small receiving dish may pick up television programs not only from his home country, but from neighboring countries as well -- a situation with which governments in Europe and Asia are increasingly familiar.

These difficulties will be exacerbated by the likely growth in digital transmissions by satellite. If government regulators are seeking to keep out certain television programs, but at the same time welcome the reception of financial information, their efforts will be substantially complicated by satellite television's likely transmission in digital, compressed form within the next few years. Similarly, proposals to deliver compact disc-quality audio via satellite to small dishes at homes (and even in moving cars) raise issues about content control; such CD transmissions will be nothing more than a stream of data bits, indistinguishable from voice or data communications except by configuration. Indeed, some of the satellite CD audio proposals would use the same equipment for digital messaging (e.g., paging) and other forms of communication.

The situation facing governments as they attempt to regulate private international satellite systems offers another illustration of the regulatory dilemmas. These satellite systems have been restricted, in order to protect Intelsat, to the provision of services "not interconnected with public switched networks." This restriction, known as the "PSN restriction" in the United States, seemed relatively simple to enforce when it was adopted in 1985, at a time when communications traffic could be divided cleanly among public switched and private line networks.

As digital communications have come increasingly to be the norm, however, the public/private distinction has become far less meaningful. When satellite communications for large users are provided primarily on a pipeline basis, as is the case on satellite systems that sell or lease transponders, it is unduly restrictive to say that that pipeline cannot be connected, at either end, to public switched networks. Large users want "seamless" networks of voice, video, and data, linking private lines with public networks around the world; they are not willing artificially to segregate their traffic to meet a government regulation that cannot be justified on efficiency grounds. If the United States and other nations insist on maintaining an artificial distinction between public and private international satellite networks, the end result will be to drive large users away from satellites altogether.

By making satellites more expensive to use, therefore, the U.S. PSN restriction promotes use of undersea cables for international communications, thereby ironically undermining the restriction's key goal -- the protection of Intelsat's PSN traffic base. These kinds of unintended consequences are likely to multiply in a world in which undifferentiated bits of data move freely among public and private, switched and nonswitched networks, domestic and international. In such a world, moreover, any attempt to enforce restrictions on PSN interconnection will ultimately be frustrating -- and a poor use of limited regulatory resources. (The author is counsel to Alpha Lyracom/Pan American Satellite, which is actively seeking elimination of the U.S. PSN restriction.)

A similar point applies to the discussion in many countries about the relative advantages of teleports versus on-premises small earth stations (often known as "VSATs") for satellite transmission and reception. To the extent that governments seek to maintain their control over monopoly communications, teleports may be a preferred solution, because they concentrate incoming and outgoing communications at a single point. From a user's perspective, however, teleports are one solution, with customer-premise earth stations being another; the choice should be made on the basis of quality and price considerations, not on the basis of regulatory fiat. Experience in the United States has demonstrated that, at least when the satellite marketplace itself is robust, there will develop a mix of teleport and customer-premises solutions, giving users the flexibility to configure their networks to meet their service needs.

In areas relating to satellite communications, then, the emerging digital networks are likely to bolster the argument for less regulation and more

freedom of choice. Because governments will no longer find it easy to differentiate among the various forms of satellite communications -- voice, video, data, switched, nonswitched -- they will find it necessary to opt for less regulation overall, leaving the satellite marketplace to work in a competitive manner.

IV. THE FUTURE OF MEDIA INTEGRATION AND REGULATION

As communications media come to be represented by digital bitstreams, the function of the regulator should be much reduced. As discussed above, pipeline offerings are neither complex nor threatening to the public interest. Rather, these offerings involve fungible commodities, and in such situations government works best when it steps back and allows the market to operate.

The notion of an open market in digital communications is not necessarily inconsistent with maintaining a role for monopoly administrations, in those countries that choose this approach. Even if the monopoly is limited to providing the basic digital pipelines, however, large users, equipment vendors, and value-added service providers will not be able to develop competitive and innovative uses of the pipelines when constrained by the pricing practices and investment decisions of the monopoly. A monopoly approach is also not well suited to the realities of cross-border satellite communications and cannot fully take advantage of the commercial and entertainment opportunities presented by this increasingly digital medium.

All communications regulators, in monopoly and multicarrier countries alike, should be prepared for the transition to what this paper has called the pipeline model. Digital communications will be increasingly the norm, and the traditional lines drawn among communications services will come to seem increasingly irrelevant. In nations where this media integration process is welcomed, rather than resisted, members of the public will be the ultimate beneficiaries, receiving better quality services at lower prices.

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LOUTCH 1 - THE ESTABLISHMENT AND OPERATION OF A MOSCOW/LONDON SATELLITE LINK

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This paper discusses some aspects of the regulatory, political and commercial environment of the European satellite business. In particular, it gives a practical account of the establishment of an Intersputnik satellite link between Moscow and London, and its integration into a global satellite network.

1. INTRODUCTION

Visnews is a global television news agency - the largest of its kind, and has made use of satellites for news gathering and distribution since video transmissions were first made possible in the early 1960s. [1]

With over 30 regular daily feeds around the world [2] satellites are now fundamental to the Agency's business. It was against this background, in 1983, that Visnews established its subsidiary, BrightStar Communications, to operate the first private transatlantic TV transponder lease and to service its own satellite needs, as well as those of other broadcasters on a commercial basis.

Following the demand for increasingly fast relay of news and sports programming, the BrightStar satellite system grew from one reversible channel to the current three transatlantic channels on Intelsat at 332.5° East. These interconnect via network operating centres in the east with a channel on Eutelsat II-F1 and another on Gorizont 30 (Statsionar 4), and in the west with a full-time channel on a US domestic satellite [3].

The system is also connected on a daily basis to various Pacific leases to feed the Western Pacific Rim. Thus it provides a "seamless" transmission route embracing most of the world from Moscow through London, Washington and LA to Tokyo.

The development of BrightStar has been driven by market forces in the television industry and the demand of users for simpler, more reliable links. But it also runs parallel with the gradual deregulation of satellite communications in different regions. The first stage took advantage of the US "Open Skies" policy; the most recent stage - the integration of a Moscow-London Link into the system - of a combination of liberalization in Europe and *perestroika* in the Soviet Union.

"Seamless" television communications have not come about easily and many compromises are still being made. The following case history charts that progress in the context of the regulatory, political and commercial environment of Europe.

2. THE PROGRESS OF DEREGULATION IN EUROPE

One of the main obstacles to the expansion of commercial satellite communications in Europe has been the regulatory environment. Only five years ago, European Telecom Organizations (TOs) had a complete monopoly of the linking of TV signals into, out of and around Europe. The only exception to this was the terrestrial closed user "Eurovision" network of the European Broadcasting Union (EBU).

At that time, in the United States, BrightStar had built co-located earth stations to connect international and US domestic satellites in order to bypass the complex routing of signals via long lines to existing switching centres [4]. By contrast, in the UK, transmissions had to be made via costly terrestrial lines to British Telecom's 30 metre international earth station on the west coast of England. No other European TO would uplink direct to BrightStar transponders.

European broadcasters wishing to use BrightStar were able to do so only by virtue of a special arrangement made with the EBU, enabling their members' material to be sent to the London Operating Centre on the Eurovision network.

This was a period when the traditional monopoly of the European national public service broadcaster was ending, and new TV stations in an increasingly competitive market were demanding better access to communications facilities.

For links between Europe and North America for non-EBU members BrightStar had two alternatives - use of Intelsat ad hoc capacity or landlines. Landlines were expensive, unreliable and re-routable in some countries, so the cost of a transmission was not known until the route had been fixed which, quite often, was not until just before the event.

The complications of routing transmissions were immense and costly, even in the UK. BrightStar was at the mercy of any increased lease charges which British Telecom chose to impose. But BrightStar's objective was to relieve broadcaster customers of worry and provide efficient links for a single, known price. This relatively simple expedient so revolutionized newsgathering operations that demand for the service increased the total amount of television traffic across the Atlantic, and made the UK an important communications centre [5].

By 1988, the introduction of 13 metre earth stations meant that transmissions could be made direct from city teleports, thus reducing the need for long-distance landlines. At that time, anxious about the UK's prominence as a television communications centre, the TOs of Germany and France (Deutsche Bundespost and

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France Telecom) reached agreement with BrightStar to uplink to its Atlantic leases from fixed earth stations in Frankfurt and Paris.

In that year, the rules on downlinking were relaxed in most European countries to permit the reception of satellite delivered television channels. The exceptions were France, Italy and Spain, although Telespazio and Telefonica did agree to uplink to BrightStar space segment from their own transportable earth stations.

The next step was for the Deutsche Bundespost and British Telecom to allow access on the same terms. The introduction of Ku-band capacity on Intelsat Atlantic had made direct uplinking from Europe highly desirable - particularly in view of a burgeoning market for live sports programming transmissions.

The apparent relaxations in the regulatory situation at this stage did not, by any means, apply universally. BrightStar was the only private international leaseholder with "common carrier" status in existence and each uplinking agreement with each country was negotiated individually, and applied only to BrightStar.

The feeling in the industry was that, as the process of deregulation and harmonization gained momentum towards the European Single Market in 1992, the different regulations existing from country to country would gradually be removed. But it was reckoning without the immense economic power and lobbying might of the Telecom Organizations - many of which were governed by ancient statutes giving them control over post, telephone and telegram systems in perpetuity. It would require considerable political will within each member country to alter the status quo.

The subject of European Telecommunications liberalization was addressed in a Green Paper by the European Commission in 1987 - but Satellite Communications were not included. This was to be tackled in a separate document scheduled for 1989.

The satellite communications Green Paper, entitled "Towards Europe-wide Systems and Services" [6] was not published until November 1990, due to an effective action fought by the French, Italian and Spanish TOs. Meanwhile the UK and Germany were working on national deregulation policies ahead of European directives, and these provided the impetus for BrightStar's subsequent development.

3. UNITED KINGDOM REGULATORY HISTORY

In the UK, the process of telecommunications deregulation began early, and satellite communications were first allowed limited private operation in November 1988.

Six Special Satellite Service Operators (SSSOs) were granted licences by the Department of Trade and Industry to offer a range of commercial television and data services: SIS, Maxwell Satellite Communications, British Aerospace, EDS, BSB, and Uplink (later acquired by Reuters and operated by BrightStar)

The licences entitled the licensees to uplink within the UK from up to three uplinks simultaneously and to downlink to any number of receivers for end use only. This meant that signals could not be relayed again from the point of reception and interconnection with the Public Switching network was not allowed. [7]

British Telecom had had a major influence on the terms of these licences, which were so limiting as to be of little practical use in commercial terms. As a result the DTI, which had a genuine desire to see satellite services develop, extended the SSSO licence in 1989 technically to include continental Europe, and in January 1990 a Class Broadcaster Downlink licence was announced which granted permission to certain entities, including BrightStar, to downlink TV signals from *"any orbiting apparatus"*. This was to be a phrase of crucial importance to BrightStar in the near future.

The new licence enabled BrightStar to downlink and onpass any TV signal and to uplink to any European satellite. Visnews European newsgathering and distribution requirements were growing at a fast pace - particularly since there were now some 40 new television stations in existence in Europe who had no access to the EBU's European (and by now also transatlantic) communications infrastructure and news exchange system. Less highly-resourced than the national broadcasters, the new stations were keen to exchange programming between themselves as well as to share transmissions from further away. The time was right for Visnews and BrightStar to lease a European transponder.[8]

The full-time channel, on Eutelsat II-F1 came into the system on 1 January 1991. It is a powerful satellite with a wide uplink footprint covering east and west Europe, Scandinavia and parts of the Middle East; ideal for satellite newsgathering (SNG) using a 1.9 metre transportable earth station. Its superbeam downlink coverage allows reception on dishes as small as 90 centimetres - although BrightStar recommends a slightly larger receiver if the signal is to be processed and re-broadcast.

Visnews set up an important European news and communications system for its customers on the satellite called VisEurope. It was fully utilized during the Gulf War and has been supremely useful for coverage of all major news and sporting events since, many of them in real time.

In August 1991, the DTI issued the UK Satellite Services Class Licence which permits uplinks to any satellite subject only to earth station approval and licensing by the Radio Agency [7]. For BrightStar, with its European network hub in London, this was the final earth segment barrier removed, allowing it to uplink direct to intercontinental satellites - and its own transatlantic leases in particular - for the first time.

With the exception of Germany, the UK regulatory position is the most advanced in Europe, but some aspects still remain to be resolved. The most important of these is right of access to space segment providers.

Ironically, direct access to private space segment providers, such as SES or Alpha Lyracom, is permitted, but the purchase of capacity on Eutelsat or Intelsat satellites must be done through the National Signatory which, in the case of the UK, is British Telecom - the main competitor of any UK private satellite service operator. [9]

In a bid to solve this problem, a separate Signatory Affairs Office (SAO) has been set up within BT but with

a notional Chinese Wall between it and BT's commercial operations. The price of Intelsat and Eutelsat space segment ordered though the SAO is yet to be decided, as there is a suggestion that significant users of space should contribute to the capital investment of the satellite consortia in proportion to their usage. There are some estimates which suggest that this could involve a 10-40% mark-up on the current satellite consortia price of a transponder.

This situation would obviously discourage buyers from using the SAO and drive them into the arms of BT or other private satellite operators. The industry ombudsman - the Office of Telecommunications (OFTEL) will eventually rule on the matter, but for the time being the position is confused and very unsatisfactory.

4. THE CURRENT REGULATORY ENVIRONMENT IN EUROPE

Access to space segment providers is a problem which exists throughout Europe, largely because Eutelsat is an organization which is governed by treaty - in the same way as the European Community - and it is larger in terms of member countries (28 in total) than the European Community itself (12 member countries). Thus the European Community's administration, the Commission, has no power of enforcement over the recommendations it makes to Eutelsat. The consortium is collectively owned, not by countries per se, but by Telecom Organizations, some of which are no longer state controlled.

In most countries there are still major blocks on the use of the earth segment too [10]. Uplinking is mainly still the prerogative of the national TO and downlinking is either officially deregulated or unofficially tolerated. The situation is further complicated in some countries where separate organizations control satellites and landlines, thus presenting two bureaucratic hurdles. Even TOs which allow uplinking to leased transponder time retain a total monopoly of access to ad hoc capacity.

The 1990 Green Paper on a common approach to satellite communications in the European Community proposed four main changes to policy:

1. Full liberalization of the earth segment including both receive-only and transmit/receive terminals subject only to type approval

2. Unrestricted access to space capacity

3. Full commercial freedom of space segment providers including direct marketing of satellite capacity to service providers and users

   (1-3 would be subject to licensing procedures)

4. Harmonization measures as far as required to facilitate the provisions of Europe wide services.

More recently - November 1991 - the EC Council of Telecommunications Ministers endorsed some of the recommendations of the Green Paper and invited the European Commission to propose measures to achieve the goals, in particular:

a. to extend the principles of the Commission Directive of 16 May 1988 on competition in markets for telecommunication terminal equipment and services to existing satellite earth stations by 1 January 1993

b. to reconcile the laws of Member States concerning existing earth stations, including the mutual recognition of standards, on the basis of the principles already established for telecommunication terminal equipment, by 1 January 1993

c. to establish a harmonized regulatory framework for satellite networks and services by 1 January 1993

d. to reinforce co-operation with CEPT according to the principles of the Council Resolution of 28 June 1990 concerning frequencies for the provision of satellite services within the Community

e. to guarantee free circulation and transborder use of mobile and transportable satellite earth stations throughout the Community by 1 January 1993

f. to establish non-discriminatory, accelerated procedures for the establishment of separate satellite systems

g. to improve and widen access to the space segments of intergovernmental organizations - taking account of special or exclusive rights for the provision of public telecommunications services.

On first reading this looks very promising, but in practice two points must be remarked: Firstly, notice the subtle difference between point 2 of the original proposal - *"unrestricted access to space segment providers"* and point g, *"to improve and widen access to the space segments of intergovernmental organizations"*. This means that private satellite service operators will continue to have to approach Eutelsat and Intelsat through the intermediary of each member state's National Signatory - with no alleviation of the attendant surcharges which can add up to 70% to the cost of a lease.

Secondly, the mills of Community administration grind exceeding slow by commercial standards. Bearing in mind that it took two years to produce the original proposals and a further year for their endorsement by the Council of Ministers, the next stage will be the wording of 'Directives' by 1st of January 1993, and it will probably take a further year before legislation reaches the statute books. It will therefore be 1995 before any of these freedoms are enforceable under European law. In the meantime, private satellite service operators will have to rely on the political will of national Ministries to see liberalization progress in their own countries, and the goodwill of national TOs to respect the intent.

I have mentioned previously that national TOs in Europe wield considerable power. In the present transitional phase of deregulation, they are not above tactical rule-making to inhibit competition even when national policy is liberalized.

Germany was the first country in Europe to instigate a genuinely liberal environment designed to encourage private satellite service operators providing both television and data services. This took the form of a Class Licence which was announced in 1990, before the Green Paper, whereby for the payment of a moderate licence fee, uplinking could be carried out by any competent organization.

Recently, however, there has been a sudden reversion to monopolistic practices by Deutsche Bundespost Telekom, acting unilaterally without the sanction of the Telecommunications Ministry. In November 1991, Deutsche Telekom imposed without notice ruling that restricted access from Germany to German space capacity only. BrightStar, on the eve of a transmission contract involving some 50 hours of sports programming feeds for various clients booked on its own space capacity, was the victim.

The only solution acceptable to DBP Telekom was a lease-back and re-lease procedure [11], that is BrightStar returned its capacity to Eutelsat, who in turn leased it to DBP Telekom, who re-sold it to BrightStar with a 33% surcharge. This procedure resulted in a loss to BrightStar of many thousands of pounds. In spite of pressure from the German Ministry of Telecommunications, the European Commission, and even from Eutelsat, the situation continued and is now subject to legal review (at November 1991).

This demonstrates that, to be a private satellite services operator in Europe, it is wise never to make assumptions, and always to anticipate a 'worst case' scenario. Fortunately, as an engineer this comes easily to me. It is much harder for the people in sales and marketing to swallow.

By contrast to the German experience, British Telecom is so far abiding by UK law [7]. Indeed, the 1990 Class Broadcaster Downlink Licence proved to be the spur for the next stage in the development of the BrightStar system.

5. THE MOSCOW CONNEXION

As events in Eastern Europe concentrated news attention on Moscow, Visnews and BrightStar were keen to improve transmission links with that region. Investigations showed that the phrase in the Class Downlink Licence allowing the downlinking and onpassing of signals from *"any orbiting apparatus"*, included the Intersputnik system. So in March 1990, BrightStar approached Intersputnik about the possibility of using a Ku transponder on one of its satellites. Thanks to *perestroika*, Intersputnik responded enthusiastically to the idea [12]. Agreement was quickly reached for one hour per day on the Loutch transponder on Gorizont Statsionar 4, transmitted from Moscow and received in London on a transportable terminal until a permanent TVRO could be installed. Service began, appropriately, on 23rd April - St George's Day (patron saint of England and the city of Moscow).

There are said to be three things that work in Moscow - the Metro, the heating and the snow clearance. BrightStar found a fourth - Intersputnik! However, the bureaucracy, uncertainty and lack of hard currency makes everything else very difficult. All materials down to nails and screws have to be imported!

Microwave links in Moscow are very expensive and cost the same whether the equipment is self-provided or not. As lack of hard currency prevents the TO from importing microwave equipment, there is little alternative to self-provision.

Intersputnik has a considerable stock of satellites [13]. It will be noted that the Statsionar number refers to the orbital slot; Gorizont is the satellite type and Loutch is the Ku transponder on a Gorizont satellite.

There are one or two difficulties in using the Gorizont satellite - one is that the signal is of circular polarization and the other is that the satellite is in inclined orbit. In choosing its permanent receive earth station for the link, BrightStar decided upon a linearly polarized 4.5 metre Scientific Atlanta TVRO with automatic tracking. This allowed its use also as a receiver for other western satellites and it came into operation in October 1990. As there is only one Ku transponder on the satellite, the only disadvantage was a 3dB loss of signal.

The present routing of the signal is from the joint Visnews/NBC/BrightStar offices in Gruzinsky Pereulok (premises are also hard to come by in Moscow), by microwave to the Ostankino tower and then by microwave to the 11 metre uplink at Dubna earth station north of the city.

From there, signals are received at BrightStar's Network Control Centre in London, from where they can be relayed instantly on other parts of the Network, or on other satellite systems [3].

6. AUGUST 1991

Having operated the Moscow-London link for a year with an excellent response from Visnews' and BrightStar customers, it was decided to increase the commitment on Loutch to nine hours a day. When the formalities had been resolved, BrightStar had the choice of starting the service at the end of July or the end of August.

The end of August was favoured as, in the words of journalists in the know: *"nothing ever happens in Moscow in August"*, but as the Moscow Summit was scheduled for the end of July, a start date of 27th July was fixed. Thus BrightStar's expanded operation was ready for the abortive Kremlin coup during which up to 150 transmissions a day were fed out of the Moscow operating centre, beginning with the first television pictures out of Red Square.

Transmissions were relayed without pause from London throughout Europe via Eutelsat II-F1, and via BrightStar's transatlantic link to North America and on to the Pacific - thus providing continuous, almost world wide distribution.

7. THE FUTURE

In as much as it is possible to make firm plans, rather than to declare intentions, for the future in the satellite services business, BrightStar is presently working on a number of improvements to the structure of the network.

The earliest of these is a move and expansion of the transatlantic sector to four channels on the new Intelsat K satellite in June 1992 [14], with a view to incorporating South America into the service, and of improving flexibility for uplinking and multi-downlinking. The all-Ku satellite lends itself, like Eutelsat II, to the use of lightweight transportable earth stations. It is also suitable for roof-top reception on small TVROs - a factor increasingly demanded by broadcasters and business television users who have their own receiving equipment.

There are also plans to expand operations on the Pacific sector, and various options on the Indian Ocean region are being studied.

In Europe, many opportunities exist pending improvements to the regulatory environment, and

BrightStar's role will for some time be in lobbying to this end. We would like to see regulations in whole regions harmonized along the lines recommended in the European Commission's Green Paper. Television and ad hoc television is very labour intensive and, in it's history, BrightStar has continued to build a myriad of small users of satellites up to the level where they take their own leases, at which time they have become direct customers of the TOs and the space segment providers.

There is sufficient commercial risk in the satellite services business without the added disadvantage of impediments imposed by TOs and others taking advantage of their dominant status. As BrightStar and similar organizations provide the software to build the market, it is in the general interest that they be able to continue that work unhindered.

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REFERENCE 1

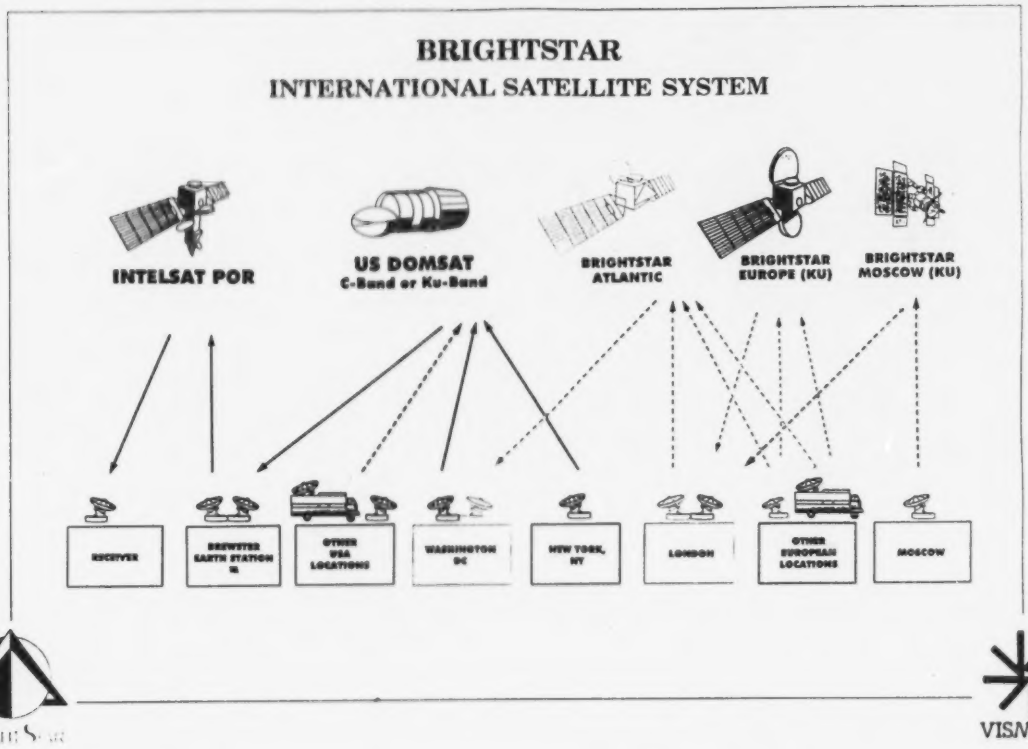
VISNEWS MILESTONES

23 NOV 1963	First satellite transmission of news story across Atlantic
13 MAY 1975	First daily satellite feed to Australia (ASPAC)
15 MAR 1976	First daily satellite feed to the Middle East
01 NOV 1976	Japan Pool joins ASPAC
01 MAR 1978	First daily satellite feed to North and South America (LANA)
01 APR 1979	First daily satellite feed from New York to Australia (TRANSPAC)
13 SEP 1983	BrightStar commences transatlantic service: first with common carrier status
16 DEC 1985	First daily feed using EUTELSAT to Sat-1
17 AUG 1987	VisAsia: five-day service from Tokyo to Asia
01 JAN 1988	BrightStar leases second Atlantic transponder
01 MAY 1989	First hotswitched service on an Intelsat system (VisAsia)
23 OCT 1989	News distribution to Latin America via Panamsat
28 OCT 1989	First daily satellite feed into Eastern Europe
01 JAN 1990	BrightStar leases third Atlantic transponder
02 JAN 1990	British Government grants BrightStar downlink licence
23 APR 1990	First daily satellite feed from Moscow
01 JUN 1990	Regular EUTELSAT transmissions from Visnews premises

REFERENCE 2

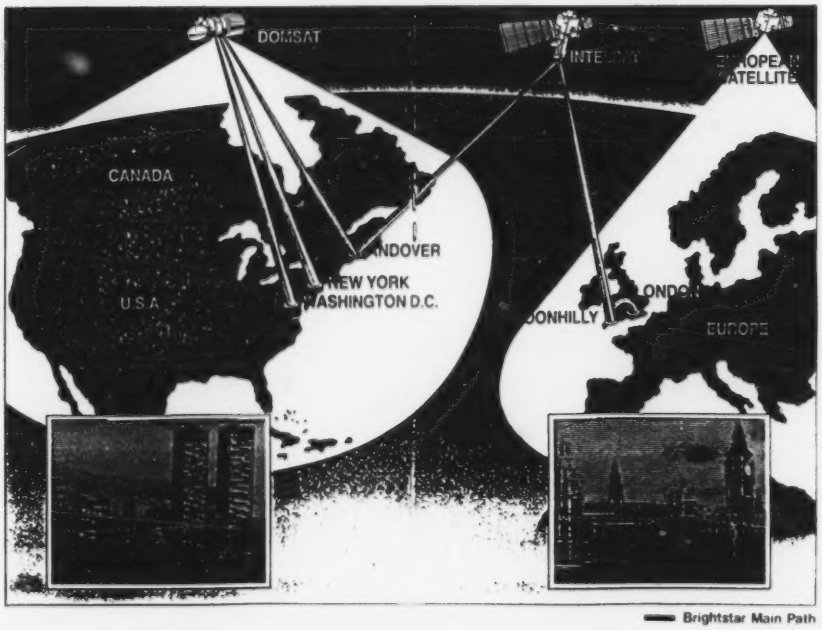
VISNEWS REGULAR SATELLITE FEEDS

GMT	ORIGIN	DAYS	SATELLITES	STANDARD
0130-0140	New York	Daily	JISO	525
0130-0140	New York	Monday to Friday	B-Star 44/74	625
0330-0340	New York	Daily	Domsat/Pac 180	525
0340-0355	New York	Monday to Friday	Domsat/Pac 180	525
0730-0737	Hong Kong	Monday to Friday	Indian Ocean P	625
0738-0750	Tokyo	Monday to Friday	Indian Ocean P	525
0750-0800	Tokyo	Monday to Friday	Indian Ocean	525
1050-1100	Moscow	Daily	Loutch	625
1200-1300	New York	Monday to Friday	B-Star 44/74	625
1355-1450	London	Monday to Friday	B-Star/JISO	525
1250-1300	London	Monday to Friday	Indian Ocean P	525
1400-1430	London	Wednesdays only	Indian Ocean P	625
1430-1500	London	Daily	Indian Ocean P	625
1430-1455	London	Daily	EUT II Flt 1 Txp 40	625
1500-1530	London	Tuesdays only	EUT II Flt 1 Txp 40	625
1550-1600	Moscow	Daily	Loutch	625
1530-1600	London	Daily	EUT II Flt 1 Txp 40	625
1700-1710	London	Daily	Atlantic Primary	625
1700-1715	London	Daily	EUT II Flt 1 Txp 40	625
1715-1730	London	Daily	EUT II Flt 1 Txp 40	625
1730-1750	Moscow	Monday to Friday	Loutch	625
1730-1800	London	Monday to Friday	EUT II Flt 1 Txp 40	625
1800-1830	London	Sunday to Thursday	B-Star/Pac 180	625
1900-1925	London	Mondays only	B-Star	525
2010-2020	London	Daily	B-Star/JISO	525
2050-2100	Moscow	Daily	Loutch	625
2100-2110	Moscow	Monday to Friday	Loutch	625
2015-2045	London	Wednesdays only	Indian Ocean P	625
2045-2100	London	Daily	Indian Ocean P	625
2140-2155	London	Daily	B-Star/Panamsat	525
2155-2225	London	Daily	B-Star	525
2215-2235	London	Mondays	Indian Ocean M	625
2215-2230	London	Thursdays	Indian Ocean M	625
2255-2325	London	Daily	B-Star/Pac 180	625
2325-2400	New York	Monday to Friday	B-Star 44/74	625



BrightStar

VISNEWS



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REFERENCE 5

INTELSAT OCCASIONAL USE TV CHANNEL HOURS 1965 - 1987

	PACIFIC	INDIAN	ATLANTIC	TOTAL
1965	-	-	-	-
1970	-	-	-	-
1975	-	-	-	8,000
1980	3,500	9,000	16,000	28,500
1985	5,500	18,000	26,500	50,000
1986	8,500	20,000	31,500	60,000
1987	8,500	20,500	26,000	55,000

REFERENCE 6

KEY DATES IN EC TELECOMS REGULATIONS

EEC TREATY	1957
EUROPEAN COMMUNITIES ACT	1972
EUROPEAN SINGLE MARKET ACT	1985
DIRECTIVE - "TELEVISION WITHOUT FRONTIERS"	1987
GREEN PAPER - TELECOMS SERVICES AND TERMINAL EQUIPMENT	JUNE 1987
DIRECTIVE - TELECOM TERMINAL EQUIPMENT	MAY 1988
DIRECTIVE - TELECOM SERVICES	JUNE 1990
GREEN PAPER - SATELLITE SERVICES	NOVEMBER 1990
DIRECTIVE - SATELLITE SERVICES	??????

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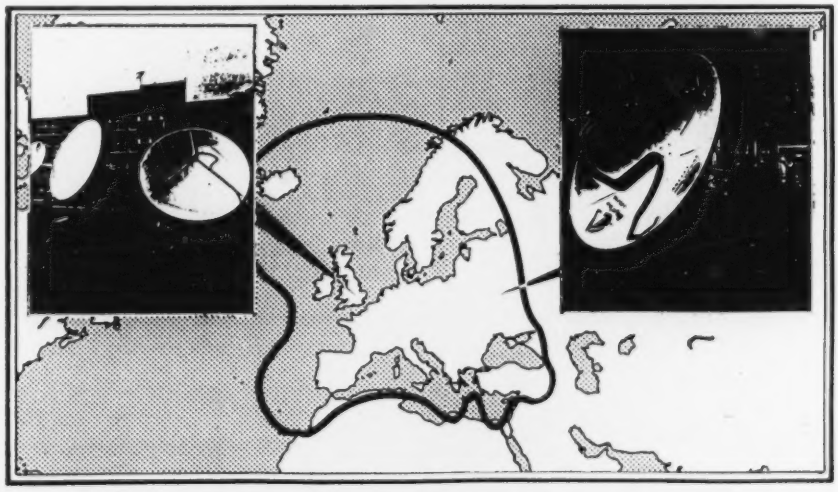
KEY DATES IN UK SATELLITE COMMUNICATIONS

SSSO LICENCES	**OCTOBER 1988**
SSSO - UK-ONLY RESTRICTION LIFTED	**NOVEMBER 1989**
DOWNLINK CLASS LICENCE	**JANUARY 1990**
UK TELECOMS GREEN PAPER	**NOVEMBER 1990**
UK TELECOMS WHITE PAPER	**MARCH 1991**
CLASS SATELLITE LICENCE	**AUGUST 1991**

BRIGHTSTAR EUROPE

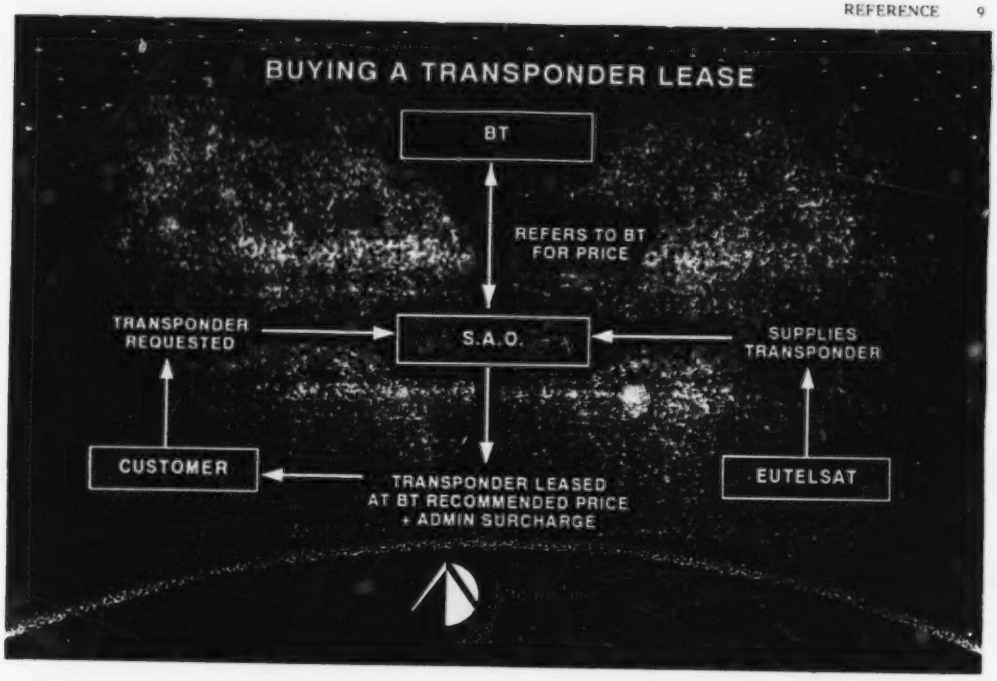


SATELLITE NEWS GATHERING (SNG) UPLINKS
DOWNLINK ONTO 1.5 METRE DISH
AT ANY EUROPEAN NEWS BUREAU

BRIGHTSTAR

VISNEWS

REFERENCE 9



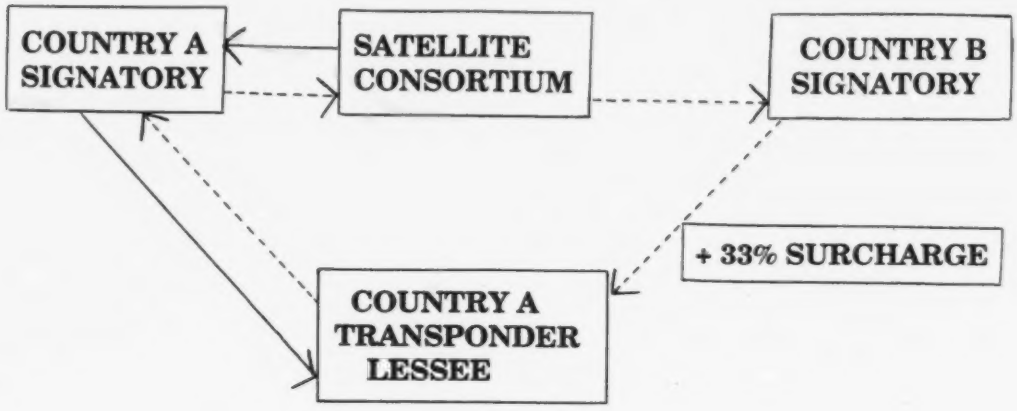
REFERENCE 10

REGULATORY ENVIRONMENT OF SATELLITE COMMUNICATIONS IN COMMUNITY MEMBER STATES

COUNTRY	RECEIVE ONLY TERMINALS		HUB STATIONS & ONE-WAY SERVICES		TRANSMIT/RECEIVE TERMINAL HUB STATIONS TWO-WAY SERVICES	
	TELEVISION	OTHER SERVICES	NATIONAL	INTERNATIONAL	NATIONAL	INTERNATIONAL
BELGIUM	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	##############	##############	##############	##############
DENMARK	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	>>>>>>>>######	>>>>>>>>######	##############	##############
FRANCE	>>>>>>>>>>>>>>	##############	##############	##############	##############	##############
GERMANY	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>
GREECE	>>>>>>>	>>>>>>>>>>>>>>	##############	##############	##############	##############
IRELAND		>>>>>>>>>>>>>>	>>>>>>>>######	>>>>>>>>######	>>>>>>>>######	>>>>>>>>######
ITALY	##############	##############	##############	##############	##############	##############
LUXEMBOURG		>>>>>>>>>>>>>>	##############	##############	##############	##############
NETHERLANDS		>>>>>>>>>>>>>>	>>>>>>>>######	>>>>>>>>######	>>>>>>>>######	>>>>>>>>######
PORTUGAL	>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	##############	##############	##############	##############
SPAIN		>>>>>>>>>>>>>>	##############	##############	##############	##############
UK			>>>>>>>>>>>>>>	>>>>>>>>>>>>>>	xxxxxxxxxxxxx	xxxxxxxxxxxxx

##############	SUPPLY EXCLUSIVE TO TELECOM ORGANISATION
>>>>>>>>>>>>>>	1990 - PRIVATE SUPPLY SUBJECT TO LICENCE
xxxxxxxxxxxxx	1991 - PRIVATE SUPPLY SUBJECT TO LICENCE
	PRIVATE SUPPLY WITHOUT LICENCE

SPACE SEGMENT LEASE-BACK AND RELEASE PROCEDURE



——— TRANSPONDER PURCHASE

- - - - - - - SPACE SEGMENT LEASE-BACK/RELEASE

BRIGHTSTAR MOSCOW

GORIZONT 12,STATSIONAR 4 AT 14° WEST
TRANSPONDER - LOUTCH 36 MHZ KU- BAND

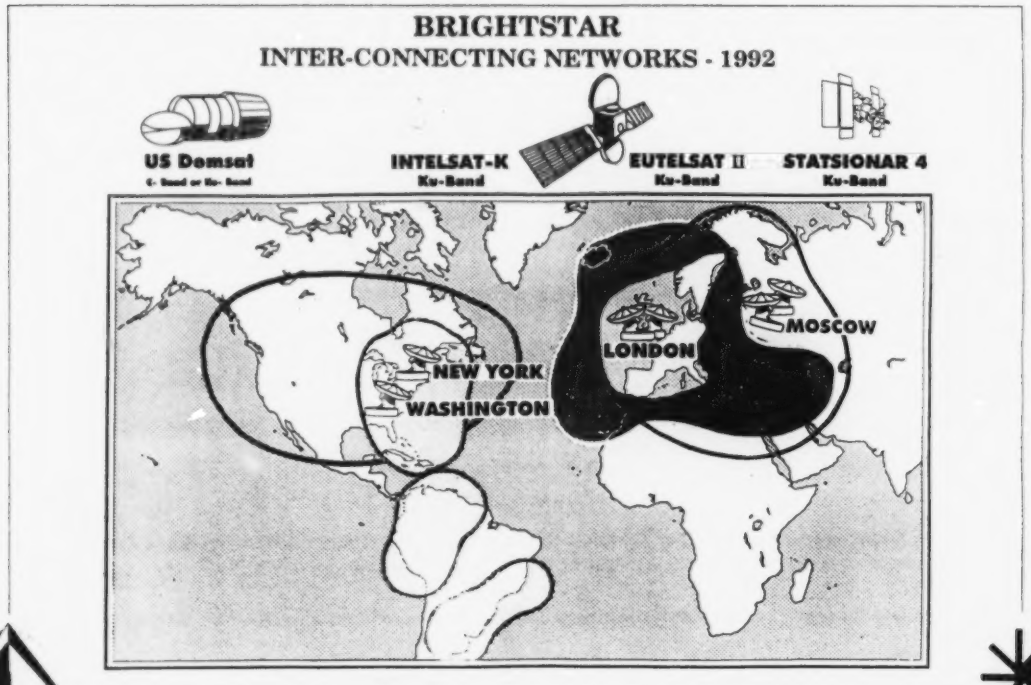
- ONE HOP FROM MOSCOW TO 4.5 M DISH IN EUROPE
- OR TO BRIGHTSTAR LONDON FOR IMMEDIATE RELAY ON OTHER SATELLITES

Brightstar

VISNEWS

SOME INTERPUTNIK SATELLITES

STATIONAR	LONGITUDE	LOUTCH	SATELLITE	DATE OF LAUNCH
4	14 degrees west	L01	GORIZONT 30	20.6.90
11	11 degrees west	L06	GORIZONT 26	10.3.88
12	40 degrees east	L07	GORIZONT 33	22.12.90
5	53 degrees east	L02	GORIZONT 29	26.1.89
13	80 degrees east	L08	GORIZONT 16	18.8.88/35-23.10.91
6	90 degrees east	L03	GORIZONT 32	3.11.90
14	96.5 degrees east	L09	GORIZONT 31	29.9.89
21	103 degrees east	L05	GORIZONT 34	2.7.91
7	140 degrees east	L04	GORIZONT 27	12.7.89



VISNEWS

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Korea's Experiences in Telecommunications

by

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Abstract

As Korea ushered into an era for one telephone per household with 10 million telephone lines installed in 1987, the function of telephone was not limited to the voice transmission but further extended to the various value-added services. In an effort to facilitate the extended communication and information services, Korea plans not only to launch its own satellite by 1995 but to install a fiber-optical cable network from 1992. Using this kind of technologies, Korea plans to integrate the various information and communication services into a single network system like ISDN.

I. Background

The telecommunications in Korea has experienced a rapid development both quantitatively and qualitatively in a comparatively short period of time since the first telephone line was installed between Seoul and Inchon, 35km apart.

As Korea ushered in an era for one telephone per household with 10 million telephone lines installed in 1987, the function of telephone was not limited to the voice transmission but further extended to the various value-added services. Korea began data transmission service over telephone in 1983. Accordingly, the information sector loomed very significant in industry, comprising 7.4% in the growth national product (GNP) with $17.7 billion in 1990. The telecommunications part composed 34.5% with $6.09 billion in the information sector.[1]

In an attempt to meet the ever increasing demand of telecommunications, Korea plans to launch its own satellite by 1995. The planned satellite system is geared both for the transmission and broadcasting. Korea designated a foreign company to manufacture the sattllite in December 1991. The planned satellite, called the KOREASAT will include 12 circuits for transmission as well as three circuits for broadcasting. Korea plans to domestically manufacture the satellite system by 2000.

The telecommunications sector, including the planned satellite system, shows the various and significant aspects both in the fields of business and technology.

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First, from a point of business, there is a great demand for the mobile transmission and communication. To meet this demand, the licensing will be open to competition. The international telephone service, traditionally monopolized by Korea Telecom, will compete with DACOM(Data Corporation) as the Korean Government allowed the latter to join this service in December 1991. In the meantime, the videotex service, formerly monopolized by DACOM, was allowed to compete with Korea Telecom. Accordingly, Korea Telecom launched a videotex service, called the HiTel, from July 1991, covering 10,000 households in three major areas: Yuiedo in Seoul, Kwachon in Kyunggi Province and Kwangju City.

Second, viewed from a technological point, Korea Telecom plans to complete the optical fiber system by 2006, beginning its work in 1992. Meanwhile, ETRI (Electronics and Telecommunications Research Institute) plans to jointly develop a multi-media system along with other private firms. The metropolitan newspapers have recently installed the nation-wide fax network called 'fax press' to simultaneously print their newspapers in various parts of the country. Korea also started a demonstration service for ISDN from October 1991, covering five hundred households in three major areas, including Seoul. The commercial service for ISDN will start in 1994.

Ultimately, Korea hopes to integrate the various information and communication services into a single system like ISDN.

Under this backdrop, this paper intends to specifically focus on three research questions as follows:

1. this paper will examine the process and prospect for the planned satellite system and the possibility of its linkage to other media systems.

2. this paper intends to look the Korean videotex plan, including the HiTEL sponsored by the Korea Telecom.

3. this paper will examine the relevant issues to better develop the planned ISDN system.

Ⅱ. The Satellite Project

The satellite service began in Korea in 1970 when the nation had installed the first earth station at Keum-san. Korea became a member of the Intelsat in 1967. Korea was allocated the six satellite channels and a slot for the satellite at 116 degrees East on the equator line at the WARC conventions in 1977 and 1979.

The Korea Advanced Institute of Science and Technology (KAIST) did a feasibility study towards introducing the satellite system in 1984. The study designated the period of 1987-1991 as a preliminary stage to complete a blueprint to introduce the satellite system.[2]

According to this blueprint, Korea Telecom, the satellite project organizer, held a briefing session about the project in February 1991 for about 60 representatives from the 27 prospective bidders. The $450 million satellite project, dubbed KOREASAT, will have the capacity for 3,900 voice circuits, three television broadcasting channels and four video channels.

Among the 27 bidding corporations were 17 foreign companies; they included Hughes Aircraft, TRW, General Dynamics, GE and McDonnell Douglas of the United States, Aerospatiale of France, British Aerospace of Britain, MBB of Germany, and NEC and Mitsubish of Japan.

Korea Telecom announced two preliminary consorsium bidders in October 1991--General Electric of the United States with the domestic Lucky Gold Star and British Aerospace of Britain with the domestic Daewoo Corporation. The winner for the project was finally

announced in December 1991 out of the two bidders as General Electronic associated with domestic Lucky Gold Star. The selection was based on the willingness to hand over the core technology.[3]

Based on this initial satellite project, the Korea satellite program will proceed at three stages in the future.[4]

The first period (1992-1995) will be focused on the preliminarily demonstration service. Korea Telecom plans to lease a transponder from the Intelsat-VA in operation to demonstrably offer the satellite communication service. It will also try to build a base towards achieving the first generation KOREASAT business venture. Among the available services during this period will be the transmission service for tele-conference, data & video transmission service.

The second period (1995-2005) is an operational business service stage for KOREASAT. Korea Telecom plans to launch its own satellite through which the broadcasting and the various data services will be available. To support this project, Korea Telecom plans to build the satellite control system, composed of Satellite Control Center (SCC) and two auxiliary control sub-systems.

The third period (after 2005) is a stage during which Korea plans to domestically manufacture the satellite system based on the technology transfer and accumulation during the second stage.

Among the notable things in this project is the linkage of satellite project to broadcasting. The propect of this linkage was expressed by the Minister of Information when he met the mid-career broadcasters in July 1991. In this briefing session, the Minister of Information disclosed a plan to include three DBS channels and four video-transmission channels in the satellite to be launched in 1995. Korea Broadcasting System (KBS) in under instruction to study using these channels.[5]

This kind of linkable plan seems significant as the nation ushers into an era for multi media and broadcasting systems as well as the nation is supposed to focus on the broadcasting structure to face up to the unification between North and South Korea in the 21st century. The introduction of satellite seems vital when the nation is developing HDTV. The satellite system is to integrate the various broadcasting services—the tradition broadcasting, CATV and HDTV.

Ⅲ. The Situation and Prospect of Videotex

The videotex plan was made in Korea in 1982. DACOM was responsible for the early stage of development. However, some metropolitan newspapers, especially economic dailies, and service companies joined this project to diversify its services. In addition, Korea Telecom started to demonstrate videotex service from July 1991, mentioned elsewhere. This service covers 10,000 households in three different places across the nation—Yuiedo in Seoul, Kwachon in Kyunggi Province and Kwangju city. In the meantime, KBS and MBC began teletex services respectively.

DACOM began the videotex service in 1985. The number of user has showed a steady growth—249 in 1986, 612 in 1987, 1,717 in 1988, 5,325 in 1989, and 6,400 in 1990. The growth of this kind is obviously related to the increasing penetration of PCs.[6]

DACOM is currently the largest data bank for this kind of service with 700,000 bits of data in 70 kinds, including 42 kinds of daily life.

The videotex service in France has been a model case especially applied to the positive public service.

Korea Telecom started the videotex service, dubbed HiTEL, in 1991, modeled on the France case. In addition, the introduction of videotex service by Korea Telecom seems to indicate that KT is going to transform the current telephone service into a computer and communication service.

The KT-sponsored videotex service plans to develop its services as follows.[7]

First, KT plans to provide 450 kinds of data service as an initial stage from 1991, including telephone directory, daily life information, educational and medical information. This kind of data services will be based on data bank, developed by KT itself as well as data bank separatively developed by some daily newspapers and DACOM.

Second, KT plans to install PSDN for data service only, fax network for fax service only, CSDN for switching the telephone network into the information network, and HDDN for ultra-speed transmission of mass information. Ultimately, KT plans to integrate this kind of individual networks into a single network, called ISDN.

Korea Telecom plans to invest 1,500 billion Won ($20 billion) by 1996 for this project. Included in this fund are 660 billion Won($880 million) for supply of PCs, 160 billion Won($213 million) for transmission network, 160 billion Won($213 million) for data base, and 47 billion Won($62 million) for voice transmission.

The participation by KT, therefore, is likely to accelerate not only the videotex service but expand the transmission network.

IV. The Plan and Subjects of ISDN

The building of a ISDN is not only a core area of the future information and communication policy but a significant part in its utility of service area.

Korea has formulated a gradual policy since 1984 towards building a ISDN network system. According to this plan, Korea designated the period of 1984-1991 as a preliminary stage during which the digitization of transmission network and the standardization of relevant technologies are to be fulfilled. During the second period (1992-1996), the transmission network will be mostly digitized, the technology of ISDN will be domestically feasible, and the commercial service for ISDN will be available. The third period (1997 and after) will be characterized by an expansion stage during which the ISDN service will spread across the nation, and the various information and communication networks will be integrated into a single network, ISDN.

As a preliminary stage to fulfill this kind of plan, Korea plans to install a fiber-optical cable from 1992, divided into three stages shown as follows.[9]

During the first period (1992-1996), Korea Telecom plans to provide 1200 fiber optical transmission systems to 797,000 users, and formulate a demonstration city equipped with the fiber optical cable.

During the second period (1997-2000), about a thousand fiber optical transmission systems will be established around the area where high-rise apartments are congested in an effort to cover 4.65 million households. During the third period (2,006 and after), some 1,900 fiber optical systems will be additionally installed to cover 12.74 million households. By 2017, all user networks will be converted into fiber optics.

The plan for this ISDN will form an axial power along with a satellite plan to face up to the forthcoming information society in the 21st century. The developmental stage will comprise (1) the development and

experiment of ISDN, (2) the development of commercial technology for ISDN, (3) the establishment of demonstration service for ISDN, (4) the linkage of demonstration service to commercial service, (5) the development and establishment of the applied service model, (6) the plan and implementation stage for an ISDN to be internationally interactive.[10]

To fulfill this project for ISDN, First, Korea will need manpower enough to establish and operate ISDN. Second, the user service should be developed as well as expanded. Third, the necessity of ISDN should be expanded by increasing various new services.

Fourth, the technology of ISDN shall be standardized in order to maximize its service to industry.

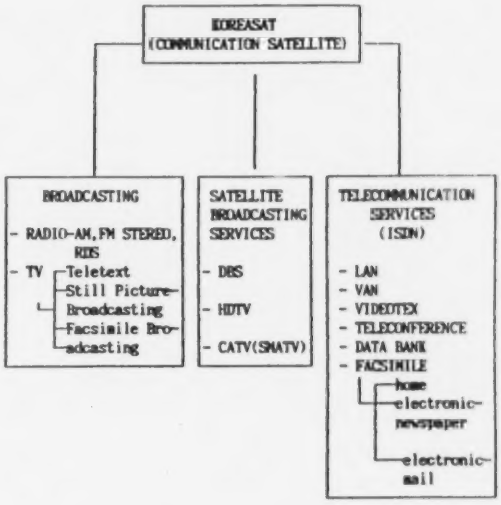
Fifth, an international cooperation and competition will be encouraged to upgrade quality of this service.

V. Summary & Conclusion

As mentioned above, the field of telecommunications in Korea is supposed to advance its technology ultimately to fulfill an integrated ISDN service as this area of service is gradually open to competition.

The positive and consistent implementation for the KOREASAT project and ISDN plan will be vital to the national communication and information policy in that it is most likely to form the core in the coming information society. The integrated service-the ultimate objective in an information society, will be possible when the services of ISDN and satellite system are closely linked. This kind of linkage service is showed in the following diagram.

This kind of integrated service will not only improve the various communication and information services, but increase the potential of users. It is also most likely to upgrade the technology of telecommunications enough to compete internationally.



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Regional Economic Integration or the Global Village

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1. ABSTRACT

Are the developments in so-called intelligent electronics more conducive to regional economic integration than to progress towards the global village? How do they affect what Lee Kuan Yew referred to as "the intangibles", "the coherence of a society", and the ways in which societies link together?

THE GLOBAL VILLAGE: VISIONS AND REALITIES

For many the road to the global village has been mapped; it is smooth and well-defined. Having few doubts about the quality of life they believe the often startling developments in information and communication technologies enable us to achieve, they wish to hurry down this road to "the technological wonderland of tomorrow"(1). The machines, the terminology and the expectations are all in place. We have facsimile, ATMs, VCRs, CDs, cellular phones. Language now accommodates hypermedia, knowbots, and virtual reality. The wired city has been replaced by worldwide interconnectivity, replete with a myriad gadgets of intelligent electronics.

For The New York Times the 1980s were when information accelerated. The editorial marking the end of the decade declared that "The 1980s now bequeath to the 1990s their exhilaration and their acceleration - and, lest anyone forget, their relentless miseries. The poor. The addicted. The uneducated. As this decade was shaped by decades past, so it will shape the next"(2). Shifting our attention from the American to the world scene, we might note that the globalization process is not as far advanced and not as equitable in its impact as we have been led to believe. Over half the world's population is not yet within two hours walking distance of a telephone!(3)

Such aspects of reality are in sharp contrast to the buzzword usage. For example, in a recent Cadbury Schweppes advertisement in The Economist the word GLOBAL features prominently although there is nothing in the ad. that distinguishes any local, regional, international or global dimensions(4). It would seem that in this popular version of globalization, there is an implicit assumption that good and equitable use will be made of information. Technologies rather than information are apparently what matter. Information is thought of as like lubricating oil; its presence makes things work better - it assures wise decisions and efficient markets. It spreads further on a level surface, which, if it happens to be a playing field, incidentally helps ensure competition.

This simplistic view fails to reckon with a variety of costs: the costs of thinking, of agreeing, of foresight. It fails to reckon with a variety of constraints: psychological, cultural and organizational constraints. In Daniel Bell's words: The new production technologies emphasize small scales and regionalization, customization, and adaptability. But the structure of trade and exchange, of capital and currency, on the other hand, are becoming more worldwide and integrated. So what you have is a mismatch of scales. Actually, it is even more complicated than that. Production is becoming more local and regional; trade is becoming more continental; and capital and currency markets are becoming more international. So you're going to get continental economies of scale, regional economies for production, and international economies for capital and currencies. And where will the nation state be? It is caught in between all these conflicting elements (5).

Of course, we might wish to debate some elements of Bell's reasoning but he has set forth reasonable working hypotheses relating to the economic aspects.

These economic aspects are related to the constraints I mentioned. When we take account of those psychological, cultural and organizational constraints, steep gradients emerge as between those with phones and those without, those with information-handling capability or organizational capital and those without, those with information resources and those without. Invoke such conventional economic concepts as complementarity and investment and this information-intensive world displays significant asymmetries in, for example, income and innovation, and clearly

identifiable patterns of cohesion, such as, for example, regional trading blocs and the proliferating forms of international governmental and non-governmental institutional development(6).

ASYMMETRY AND TRADE

The trading possibilites that are fundamental to the functioning of an economy arise from individual differences. These asymmetries, especially those of information and organization, must be viewed in the context of the global economy. The word global means pertaining to or embracing the totality of a group of items, categories, or the like. In relation to economic activity, it would seem to imply, at a minimum, the involvement of all economies. But that involvement could well be limited, both in terms of the volume and variety of trade. At the other extreme - and this would seem to fit well with the popular global village thinking - there would be complete economic integration. Can there be anything that might be described as complete integration while individual differences of information and organization remain? Perhaps we should see the global economy with the set of individual economies showing diversity in respect of both position within this integration spectrum and overall size.

In one of the few theoretical papers that explore the workings of a global economy, Holland notes the following features:

1. The overall direction of the economy is determined by the interaction of many dispersed units acting in parallel. The action of any given unit depends upon the state and actions of a limited number of other units.

2. There are rarely any global controls on interactions-controls are provided by mechanisms of competition and coordination between units, mediated by standard operating procedures, assigned roles and shifting associations.

3. The economy has many levels of organization and interaction. Units at any given level typically serve as "building blocks" for constructing units at the next higher level. The overall organization is more than hierarchical, with all sorts of tangling interactions (associations, channels of communication) across levels.

4. The building blocks are recombined and revised continually as the system accumulates experience - the system adapts.

5. The arena in which the economy operates is typified by many niches that can be exploited by particular adaptations; there is no universal super-competitor that can fill all niches (any more than such would be the case in a complex ecology such as a tropical forest).

6. Niches are continually created by new technologies and the very act of filling a niche provides new niches (cf. parasitism, symbiosis, competitive exclusion, etc., in ecologies). Perpetual novelty results.

7. Because the niches are various, and new niches are continually created, the economy operates far from an optimum (or global attractor). Said in another way, improvements are always possible and, indeed, occur regularly(7).

Several features of such a model might be noted in this context. First, there is an important role for accumulated experience(8). Experience and learning are the basis of improved standard operating procedures that pemit more and more sophisticated interactions between units. If culture is "a living historical product of group problem solving"(9), it readily finds a place in this analytical framework. So too would a thoery of learning.

A second feature relates to limits on adaptability. Reliance upon accumulated experience can, because of the economic characteristics of information and the organizational arrangements for information-handling, lead to failure to satisfice, failure to search for better outcomes. Culture, as defined above, ceases to be part of social capital and becomes a burden. History matters and the process leads towards organizational obsolescence(10).

A third feature can be observed when an individual economy modifies the communication links it has with the rest of the global economy. Streeten analysed the interaction of communications and technology gaps in the development process(11). A communications gap means that the existing technology is only partly or imperfectly communicated. Technology gaps can be of two kinds: the first kind result from imperfections in communicating and transferring existing technologies; the second may be due to absence of appropriate technologies. This second kind he called the suitability gap. But the more and the better advanced technology is communicated, the less likely it is that a new and more appropriate indigenous technology will be developed. Better communication reduces both the opportunity and the will to invent an indigenous technology. Closing an economy off against foreign influences, and particularly against the multinational enterprise, may be the correct policy if we wish to close the suitability gap"(12).

This reasoning was applied to the development process. However, once we treat the individual economy, developed or developing, as an organizational economy, as an economy in which what happens in organizations may be even more important than what happens in markets(13), a more general meaning of appropriateness emerges.

Technology must be appropriate to the entire resource mix: labour, capital and organization. Is it not then possible also for domestically generated technology to be inappropriate? Perhaps this is currently the case with information technology. The American story is that information-processing equipment as a percentage of all the durable equipment bought by private enterprise (excluding farms) increased from 11 per cent in 1970 to 51 per cent in 1989. In the words of The Economist, corporate America "gorged itself on information technology"(14). "Employees and information technology are companies' two biggest single expenditures. But the marriage of the two has proved most unproductive "(15).

Assigning an organizational, information-using character to the economy and its operational units may have brought greater complexity to our analysis but that may have been a price worth paying. An information-theoretic viewpoint allows a role for learning, the design of organization, sequential behaviour, time lags, and consequential diversity.

AN INFORMATION-THEORETIC VIEW OF OPTIMAL TELECOMMUNICATIONS INVESTMENT

Mainstream economics does not have a perspective on technology and the future of the information and communication industries. In so far as it has failed to recognize limitations upon our capabilities to gather and process information, to communicate, decide, and to agree amongst ourselves, mainstream economics has in effect denied the possibility of any special role for these industries. What is needed is an information-theoretic view that reckons with information processing as the dominant resource -using activity(16); a continuous activity(17) in which information is a form of capital; information is costly; information-dependence can lead to organizational obsolescence; and we have much to learn about the design of organizations(18).

If information - and it must be emphasized that technology is perhaps the most important kind of informtion - is a capital resource, we should look not only at the substitution effects that reflect powerful forces leading to the adoption of technology, but also to the way in which the various kinds of information complement each other. Because information flows are the essence of economic dynamics, the notion of complementarity here must be extended and must embrace co-evolving technologies with applications spreading into many industries. External effects in the accumulation of knowledge have a critical role in economic development(19). ICTs and the new materials technologies are an excellent illustration of this co-evolving, complementary character.

The extent of the spillovers and the interactions reflect the communication infrastructure. We must, however, be very careful in interpreting the word, infrastructure. The most common error, and one that can have quite disastrous consequences, is to equate technology in the hardware sense, i.e., equipment, with information and even with the use of information. This is done because it seems to permit the adoption of the tangible ICT equipment to be presented as a measure of how well the economy is handling the intangible information(20). In many economies where there is heavy expenditure on ICT, the reality may well be "Spending more; knowing less". Better design of organizations, more interpersonal communication and more evaluationmight well make a better contribution to economic growth. In fact, one researcher argues that US manufacturers would have done better, between 1978 and 1984 had they directed the capital invested in information technology to almost any other part of their businesses(21).

The ideas developed in the earlier sections of this paper can be applied to investment in telecommunications.

Good telecommunications are at the same time a cause, a consequence and a manifestation of development: they are one of the many contributing factors to economic growth and industrial expansion, rich countries can afford to spend comparatively much more on telecommunications services than poor countries, and available data show a close positive correlation between a country's wealth per head and the density of its telecommunications system(22).

A less balanced view emphasizing the casual role and concluding that there is substantial under-investment is widespread. It should be met with caution. We have seen other simplistic interpretations of the development process that lead to 'solutions' in terms of power generation, capital investment or the provision of technical skills. Economists should, given their inclination to stress the interdependence of the component parts of an economic system, be suspicious of such single-factor explanations, and yet they may fail to get to the core of the problem - the role of organization in the economy. All too often, they place this in the non-economic category and fail to understand that even a 'balanced' investment program can be ineffective because organizational structures are either obsolete or inappropriate. In the case of telecommunications technology, it seems necessary to remind many that the demand for telecommunications services is a derived demand- a demand that derives from the value of information used or computations made. That value in turn depends upon the 'states of readiness' of those individuals or organizations receiving it. Appreciation of this dependence requires consideration of organizational aspects.

The debate about the evaluation of telecommunications investment has been too narrowly confined. True, some features at the national level have been highlighted. The need for developing countries to use scarce foreign exchange reserves is usually mentioned. So, too, is the structure of the world telecommunications equipment supply industry and the price differentials that might result from industry strategies. But in both cases there is need to look to the general economic context. Foreign exchange may have to be rationed for all purchases of foreign technology, goods and services; and monopoly elements may pervade all the markets in which developing countries operate. It is not, therefore, practicable to treat the telecommunications system in isolation from the rest of the economy and its operation, including changes in the level of investment in the telecommunications system itself, must be judged in terms of effects on the entire economy - an analysis that begins with the derived demand relationship.

What allocation of telecommunications investment as per cent of GDP is optimal? To answer this we must ask further questions. What complementary investments are needed? What effects could be attributed to the changed telecommunications situation? How is the investment calculated: does it include the engineering and human capital? Does it include organizational capital? How important are monopoly elements in the pricing of equipment and technology acquired from abroad? Such considerations call for a wide-ranging cost-benefit study and comparison with alternative investment programs in, for example, health, education, transport, etc.

It is now clear enough that all countries will have to become users of new telecommunications technology but it seems likely that only some will, by so doing, gain the comparative advantage they are seeking. The importance of economic research in seeking out those advantages is to be found in some basic perspectives it can bring to major policy matters rather than in the equations of its too mathematical journals. In terms of the optimal telecommunications investment problems, economic analysis must emphasize both the complex interdependence between the use of telecommunications and the whole range of economic activities and the process nature of economic development. Cost-benefit calculations of the 'snap shot' kind inevitably miss a great deal of both costs and benefits and can be thoroughly misleading. Whatever the methods adopted to win a larger share of national resources, those responsible for telecommunications planning must be aware of the preconditions, the sequences and the lags that are involved in the technical choices within the telecommunications system.

Those planners mostly fail to come to grips with the preconditions, sequences and lags that arise from the telecommunications system being part of both a domestic and international economy. Those relationships are extremely complex but optimal decisions or even just reasonably sound decisions require some understanding of them. In the development context, "information is poor, scarce, maldistributed, inefficiently communicated and intensely valued"(23). Telecommunications systems cannot solve all these problems but they do have an important contribution to make - a contribution that is much enhanced by achieving a better designed infrastructure in all its dimensions.

Design of that infrastructure depends a great deal on certain characteristics of telecommunications. The most emphasized of those characteristics is probably its friction-reducing capability(24), the importance of which reflects the extent to which (a) telecommunications does in fact provide a uniform distribution of information over space; and (b) the technology and its applications are adopted by a significant share of growing information-dependent markets. In relation to regional patterns, the following need to be taken into account:

* the scale effect;
* the prior geographical distribution effect;
* information demand;
* organizational structure; and
* logistics(25).

A combination of these circumstances can moderate the initial perceptions of benefit. While the new technologies make it possible for agents to reach out from their home base and to more easily draw information from their environment, the same is true for others outside. And once made dependent upon the new facilities, agents may find that they are subject to new forms of control. Symbiotic relationships that develop gradually may hold the best prospects of benefit and may well serve as the basis for new groupings and regional blocs (26).

We should not be surprised then at the finding that "Telecommunications is reinforcing the commanding role of major business concentrations around the world ... New information technologies do have a fundamental impact on societies, and therefore on cities and regions, but their effects vary according to their interaction with the economic, social, political, and cultural processes that shape the production and use of the new technological medium (27).

Some of the integration and globalization trends seem likely to be reversed. Global dreams have already proved to be tunnel vision for financial and advertising interests. As The Economist remarked: "financial markets may indeed have turned global, but that does not mean that every financial intermediary must build a costly worldwide network. The business and the variables that determine competitive advantage are more complicated than that"(28).

Psychological distance and the limits of organization seem likely to ensure that a medieval Mediterranian trade route model will have more relevance to the near future than will the technological wonderland model of the global village. Even if Marshall McLuhan's ideas are to prove correct, the time dimension may be very long term indeed. The nearer future, I suspect, will grow out of the interaction of localized and McLuhan forces; an interaction that leaves a good deal of room for action that evolves from past experience and uses the existing resource and knowledge base. So we shall travel slowly, learning as we go, in a world of local, regional, continental and international dimensions.

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The Canada - US FTA: Telecom and Regional Free Trade

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1. Introduction

In this panel we will be seeking to address the overall question as to whether IT developments are more conducive to global (in the context of the PTC, Pan Pacific) or regional blocs. The purpose of this paper is to draw attention to the specific terms of the Canada-U.S. Free Trade Agreement (FTA) and to suggest that the FTA exemplifies the role telecommunications will play in regional economic integration. From my vantage point as a Canadian legal academic with an abiding interest in telecommunications policy and regulation, it would seem that the initiative lies with telecom furthering regional blocs rather than truly international Pan Pacific developments. Whether a North American regional trading bloc becomes a protectionist fortress or acts as a springboard for further free trade, and what role international telecom will play in all this, is, of course, The Big Question. My paper will focus on more parochial and specific concerns. However,I would argue that any attempt to address the wider issue will founder if we do not have some very precise information as to what is actually going on out there. We need to be muddled with a few facts!

2. The Historical Bilateral Transborder Regime

The development of Canada-U.S. telecommunications has been influenced by a number of factors. Historically, the exchange of telecommunications traffic across the U.S.-Canada border was greatly facilitated by the institutional similarities in the provision of telephone service. While Canada never developed a single separate long distance carrier such as AT&T Long Lines, the existence of provincially-based monopolies made it relatively simple to arrange for the exchange of traffic on a company-to-company basis. Over time, a wide range of agreements was established between Canadian carriers and AT&T which allowed for revenue settlements very similar to those already established domestically. As well, Canada adopted similar technical standards to those of the U.S., is part of the North American Numbering Plan, and the two countries have fully integrated telecommunications network infrastructures. Indeed, perhaps nowhere in the world are there two more integrated national systems. The Canada-U.S. trans-border regime has until recently been premised on the same principles as those governing the multilateral regime. There have been some striking differences, however. Perhaps the most important is the fact that, unlike the multilateral regime which given that it is treaty-based is naturally governmental in nature, the Canada-US regime has been essentially non-governmental. Although the FTA alters this somewhat, apart from several recent transborder satellite and data agreements, private not public ordering of relationships based on negotiated reciprocal advantages of exchanging traffic, has predominated.

The second major feature of the trans-border regime is that it has always been deliberately excluded from the larger international regime. Thus in 1988, the United States adopted the following position in the Final Protocol on International Telecommunications Regulations: "The United States of American formally declares that it does not, by signature of these Telecommunications Regulations, nor by any subsequent approval thereof:... c) accept any obligation in respect of the application of any provision of these Regulations to service within the United States on the one hand, and Canada, Mexico, and Saint-Pierre and Miquelon Islands on the other hand, and to the rates applicable to such service.".

3. The FTA Introduced

There has been a tendency to underestimate the importance of the FTA's provisions governing telecommunications. It is true that only computer and enhanced services are covered (with

definitions of what is included apparently left to national regulators), much existing law and policy is grandfathered, and provision is made only for national treatment, not full market access. Just the same, this recitation of limitations should not lead to the conclusion that the Agreement is in any way insignificant. In the first place, computer and enhanced services constitute a crucially important growth element in modern telecommunications. Enhanced services in Canada currently include Data Access Arrangements (a packet-switched data service), Radio Paging, Envoy 100 (a text message service), INET 2000 (a messaging and data based service), TELENET, TELTEX and TELPOST, Store and Forward Telex, Telegraph, and 911 Service. As this list of services shows, there are still relatively few enhanced services in Canada today, and they represent only a very small part of the telecommunications market. Nevertheless, there is every reason to believe that enhanced services will become increasingly more important in future. For example, there are today fewer two-way real time voice conversations with the advent of store-and-forward voice mail and electronic mail services. Other enhanced services such as home shopping and banking , and data base access and retrieval will soon grow in significance. Second, closer analysis reveals that important restraints have been placed on national regulators with respect to the crucial issue of definitions. Third, it does not appear that older policies have been automatically grandfathered with respect to measures required to prevent anti-competitive practices in the provision of enhanced services. Fourth, and most important, limited as the provisions of the Agreement may be, they mark the very first occasion that an international agreement has dealt with trade in telecommunication services. Indeed, telecommunication services is one of only three service sectors dealt with by way of a separate sectoral annex - Annex 1404C, "Computer Services and Telecommunications-Network-Based Enhanced Services." While the FTA represents more a cautious affirmation of the status quo between countries with relatively liberalized domestic arrangements than any clear signpost towards future multi-lateral agreements, the pioneering nature of the achievements of the negotiators of the Agreement need to be recognized. Indeed, given Canada's intransigent refusal to allow competition in long-distance public voice service, a corner-stone of U.S. policy, it is remarkable that anything was achieved at all in the telecommunication services sphere.

4. Why Only Computer and Enhanced Services?

Negotiations leading up to the FTA took place against a backdrop of a sharp difference in policy between Canada and the United States with respect to the role that competition should play in telecommunications. Just how highly charged this difference was may be seen in a contemporary speech of the federal Minister of Communications in which he was moved to express his condolences to the American people for the pointless destruction of a superb integrated network with the divestiture of AT&T and to promise that Canadians would never suffer a similar fate. Whatever happened, they were to be protected from "déréglementation brutale."

Yet wide as was the gap on long-distance voice competition, the incompatibility of the respective national approaches toward competition was not total. Competition had been allowed in Canada in private voice and data services, in resale and sharing, in cellular services and in terminal equipment, as well as with respect to enhanced services. It was thus possible for the negotiators to segment out computer and enhanced services for inclusion in the Agreement. Before turning to look at how this was done, it might be useful to deal briefly with the telecommunications equipment issue.

5. Integrating the Equipment Markets

In 1986, Canadian exports of telecommunications equipment to the United States amounted to $781 million, while Canadian imports amounted to $694 million. This was up from $487 and $280 million, respectively, in 1982. In 1986, the United States accounted for approximately 62 per cent of Canadian exports, and 57 per cent of Canadian imports. Canada, in turn, accounted for around 11 per cent of U.S. exports, and 13 per cent of U.S. imports of telecommunications equipment. Until 1 January 1989, tariffs on telecommunications varied widely -

Canadian duties on U.S. products ranged from 6 to 17 per cent, and resulted in a 3 to 7 per cent price disadvantage for U.S. producers. The tariffs for telephones, key systems, and private branch exchanges (PBX) were removed immediately upon implementation of the FTA in January 1989. Large switching systems were to have duties removed in three equal steps, leading to duty free status on 1 January 1991. All remaining transmissions equipment will be duty free by 1 January 1993. Fibre optic and coaxial cables have the longest tariff reduction schedule and will only become duty free by 1 January 1998.

It is interesting to note that tariffs on telecommunications equipment were originally scheduled to be phased out gradually over five years. But Canada's chief negotiator, Simon Reisman, has stated that at the urging of AT&T and other U.S. telecommunications equipment companies, Canada agreed to speed up tariff removal on some major products.

Given this background, it is not surprising to find Ken Lindhorst of AT&T expressing some satisfaction with the tariff aspects of the Agreement at the American Bar Association Convention, held in Toronto in 1988. The tariff treatment of telecommunications hardware was considered to be "the most positive element to be introduced in the Agreement." By contrast, procurement was characterized as the "most negative."

In recent years, Northern Telecom has occupied a remarkably advantageous position as a consequence of having, with Bell Canada, a common parent in Bell Canada Enterprises (BCE). As a preferred supplier, Northern Telecom has been given the opportunity to provide new telecommunication systems and equipment before requests are forwarded to other suppliers. With an assured domestic market resulting from this preferred access, Northern Telecom has been very successful in penetrating the U.S. market just at the time that the divestiture of AT&T greatly reduced any incentive for the Bell Operating Companies to stick with AT&T equipment. In the vernacular, Northern Telecom had it coming and going, "monopoly at home and competition abroad." Or to put it somewhat less crudely, "preferred access at home, equal access abroad."

This advantageous state of affairs is reflected in Canada-U.S. trade in telecommunications equipment. About two-thirds of Canada's $2.5 billion equipment market is supplied by Northern Telecom, with Bell Canada purchasing 85 per cent of its equipment from its preferred supplier. Northern Telecom has also enjoyed enormous success in the U.S. market, which now provides about two-thirds of its overall revenues.

Not unexpectedly, this contentious issue of preferential procurement has been the subject of bilateral consultations over the last four years between U.S. and Canada. Despite these concerns, this matter was not dealt with in the FTA, an issue of continuing concern to AT&T.

U.S. telecommunications equipment manufacturers have not been content simply to await developments; they made their move under the Omnibus Trade and Competitiveness Act of 1988 in an effort to gain thereby what they had failed to obtain in negotiations leading up to the FTA. Part 4, "Telecommunications Trade," of that Act provides the "crowbar" that the Americans proposed to use to achieve "an open world for trade in telecommunications products, services and investment." Section 1394(a) of the Act requires the United States Trade Representative (USTR) to "conduct an investigation to identify priority foreign countries" for the purposes of the telecommunications provisions of the Act. In its first report, the USTR has designated the European Community and Korea as "priority foreign countries."

While it is far from clear exactly what steps were taken by U.S. equipment manufacturers, it was reported that they had sought to have Canada designated as a priority country, and that the USTR decided not to do so in view of the adverse impact this would have on the implementation of the but recently concluded FTA and in view of the relatively weak case that could be made against Canada. While not raised directly by the FTA, a much larger issue is looming on the horizon. Given the huge development costs of digital switches (and the optical switches yet to come) and nearly saturated markets (dreams of China and the Soviet Union notwithstanding), it

is expected that there will be further consolidation in the near future in switch manufacturing. While Northern Telecom is seen as likely to survive, it may only do so by entering into an alliance with another large-scale manufacturer seeking access to North American and European markets, such as Ericsson. This would immediately raise highly sensitive issues, as Northern Telecom is widely perceived as Canada's one and only information technology superstar. Already there is deep concern that technology development (let alone manufacturing capacity) is being moved south. While well beyond the scope of this paper, it is evident that Canadian policy-makers need to start thinking through the implications of globalization for large-scale telecommunications equipment manufacturing in general, and for Northern Telecom in particular.

6. A Question of Standards

Given the nature of the telecommunications industry, there is always the danger that standards will be used as non-tariff barriers to trade. (The most notorious recent example of this has been in Japan-U.S. trade relations, although there has been much improvement in this regard in recent years.) Both Canadian and U.S. exporters of telecommunication products benefit from the fact that their national systems operate on compatible standards. However, each country's products still must meet certain national standards in the other country. In the past, U.S. companies have claimed that Canadian requirements are unreasonably more cumbersome than those in the United States, and that this places them at a disadvantage by slowing down the entry of their products into our markets. To support their charges, the Americans point to the Federal Communications Commission's (FCC) requirement that imported equipment must not lead to "harm to the network," while Canadian regulation requires that positive "performance" standards must be met. It was reported that U.S. negotiators at the free trade talks proposed that Canadian testing procedures be liberalized. In the end, while a general prohibition against the use of technical standards as disguised barriers to trade was included in the FTA, nothing was included specifically with respect to telecommunications equipment. The issue does not appear, however, to be a serious one, with residual concerns confined to relatively minor matters of expense and time.

However, in one area, the general commitment to eliminate the use of standards as a barrier to trade could emerge as important. The implementation of the integrated services digital network (ISDN) will most probably stimulate increased demand for a wide range of new terminal and subscriber equipment. Domestic producers on both sides of the border may be tempted to resurrect "network compatibility" arguments in order to exclude foreign suppliers from competing in emerging markets for ISDN equipment. While the FTA does not prevent either country from establishing national standards, it does require that foreign suppliers be granted equivalent access to domestic suppliers if it can be demonstrated that their products meet objective standards imposed by the authorities in either country.

7. The Telecom Sectoral Annex

Article 6 makes the limits of the Sectoral Annex very clear. As a result of an abundance of caution, specific exceptions are spelled out therein. They provide, first, that there is neither a right nor an obligation on the part of either Canada or the United States to authorize the operation of basic telecommunications transport facilities or services by "persons" of the other country. Second, nothing in the FTA precludes either country from maintaining, authorizing or designating monopolies for the provision of basic telecommunications transport facilities or service. Third, each country is permitted to mandate the use of its own basic telecommunications network for internal traffic as well as any traffic originating or terminating in that country. Canadian authorities have already announced that a statutory obligation will be placed on its carriers to employ Canadian facilities whenever feasible.

Cumulatively, the exceptions outlined in Article 6 go a long way to retain sovereignty over "basic" telecommunications. But what of "enhanced" services?

(a) **The Definition Issue**

It will come as no surprise to you to learn that certainty in language and operation were not achieved in the FTA! Yet, because inclusion is limited, definitions will be all important.

Definition-making and construing have been a very difficult process in contemporary telecommunications regulation due to the ever changing nature of technology and the myriad new services it makes possible. One only has to recall the FCC's desperate efforts to distinguish between "telephones" and "computers" and, later, "enhanced" and "basic" services, or Judge Greene's decisions on the line-of-business limitations for the Bell Operating Companies, to realize that, whatever definitions are included in the FTA itself, what is going to be crucial is who decides what is or is not a "basic" as opposed to an "enhanced" service, or what is or is not included as "computer services."

"Basic" telecommunications are said in the Agreement to mean any service, as defined and classified by measures of the regulator having jurisdiction, that is limited to the offering of transmission capacity for the movement of information. "Enhanced" service is said to mean any service offered over the basic network that is more than a basic telecommunications service, as defined and classified by measures of the regulator having jurisdiction.

An initial reaction might be to believe that basic and enhanced are whatever they are defined to be by the respective national regulators. Does this then mean that a Canadian regulatory agency could define as "basic" what its U.S. counterpart would undoubtedly consider as "enhanced" - thereby protecting its monopoly telephone company from competition? It would not appear so. This is because "basic" is declared in the Agreement itself to be limited to the offering of transmission capacity for the movement of information. Should the service, looked at objectively, be more than simple transmission, then the regulator would be without authority to deem it "basic."

"Computer services" are somewhat more straightforwardly and comprehensively defined as services - whether or not conveyed on the basic telecommunications network - that involve generating, acquiring, storing, transforming, processing, retrieving, utilizing or making available information in a computerized form, including, but not limited to: computer programming; prepackaged software; computer integrated systems design; computer processing and data preparation; information retrieval services; computer facilities management; computer leasing and rental; computer maintenance and repair; and other computer-related services, including those integral to the provision of other covered services.

This makes it apparent that the FTA contemplates the direct provision of computer services outside of a telecommunications context. With this in mind, it must be read in the wider context of services as a whole, and particularly, the Sectoral Annex on Temporary Entry for Business Persons, which will greatly ease transborder movement of computer service, sales, management, installation and maintenance personnel.

(b) **Effective Measures to Prevent Anti-competitive Conduct**

Under article 5 of the Sectoral Annex the obligation is to ensure that the monopoly shall not engage in anti-competitive conduct in the enhanced services market, and to maintain, or introduce, effective measures to prevent anti-competitive conduct. Moreover, this obligation is to be construed in accordance with a sectoral objective of supporting the further development of an open and competitive market for the provision of enhanced and computer services. The issue that then arises is whether current Canadian regulatory practices measure up to this new international obligation.

(i) **Accounting Requirements**

Over the last twenty years, major strides have been made by the federal regulator with respect to costing. Indeed, Canada has displayed great aversion to structural changes such as divestiture (and even separate subsidiaries) and has put its faith in conduct regulation and cost allocation. Initial contribution tests have given way to Phase II of the mammoth Cost Inquiry which involves the preparation of an economic evaluation of new services using an incremental approach to show that it will have a positive net present value over its useful life. Phase III provides for a

costing methodology which divides costs and revenues into a number of categories. Finally, when Bell Canada applied to introduce ALEX, a network based gateway service which allows customers with a videotext terminal or personal computer to access electronic information or transaction services, the CRTC developed a unique method for detecting cross-subsidization. It required Bell to identify and forecast all the costs and revenues associated with the market trial and to report on a quarterly basis. The regulators have, in effect, developed, a whole new accounting methodology to ensure that costs are not subsidized by any other services in either the monopoly or competitive network services category.

The crucial question for us in this dance macabre of costing methodologies is whether any of these accounting requirements meet the FTA's standards. Careful analysis will allow us to determine whether a regional agreement really has the potential to change one country's domestic regulatory regime in a manner which will allow for further integration via enhanced services. Such services, in turn, will, no doubt, facilitate yet broader economic integration.

The contribution test can in no sense be regarded as effective. As for the Phase II methodology, its fatal flaw is that actual revenues and actual costs may well be very different from even the best projections. Since the Phase II methodology does not include a method of reviewing on an annual basis whether cross-subsidization is actually taking place, it would appear that this form of accounting requirement would not satisfy Article 5.

Phase III results probably would not, in and of themselves, satisfy Article 5. As with the contribution test, it is possible for enhanced services to be subsidized by other "competitive" services. Only the methodology imposed for the ALEX market trial would appear to satisfy fully the requirements of the FTA. The methodology is scrupulous to ensure that enhanced services are not cross-subsidized. In addition, it has a benefit over the aggregate enhanced services study in that each individual service can be shown not to be subsidized. With an aggregate enhanced services study, some enhanced services may subsidize other enhanced services. This may be considered to be cross-subsidization or predatory conduct, both of which are prohibited forms of anti-competitive conduct under Article 5. The ALEX trial rules eliminate these problems. It may be no coincidence that the ALEX trial methodology was developed by the CRTC after the FTA was concluded and passed into law.

(ii) Structural Separation

The most direct way to avoid the cross-subsidization problem is to require the carrier to provide the competitive service through a structurally separate subsidiary. In this way, the assets used to provide the competitive service are not included in the rate base and cross-subsidization cannot occur. The structurally separate subsidiary can be required to obtain services from the regulated carrier at the same rates as all competitors. Since each corporation is a separate corporate entity with its own books, the relationship between the competitive and monopoly services could be scrutinized. The FCC, in its Computer II decision, required structural separation for carriers wishing to provide enhanced services. In its Computer III decision, however, the FCC began to move away from structural separation and indicated that when open network architecture (ONA) has been approved, structural separation will no longer be required.

Although structural separation is an excellent mechanism for preventing cross-subsidization and other anti-competitive practices, it has substantial drawbacks. For instance, customers who want to acquire both competitive and monopoly services from one supplier are denied the benefits of one-stop shopping. In addition, the carriers cannot take advantage of economies of network scale and scope which may be present if both the monopoly and competitive services are provided by a single corporate entity.

In Canada, there has been but little experience with structural separation in the enhanced services market. There is, however, some limited experience in the radio-telephone market.

Both Bell Canada and B.C. Tel have been required to set up arm's length affiliates to provide cellular telephone services. It is

widely agreed that the use of structural separation in the cellular market has worked well. But, in March 1986, the CRTC announced that it would not require Bell or B.C. Tel to provide competitive multi-line and data terminal equipment through a separate affiliate.

In assessing whether a separate subsidiary could ever be required under the FTA, it should be most carefully noted that the move away from separate subsidiaries in the U.S. came about only when it was determined that open network architecture could prove to be an adequate substitute. This approach is captured in the reference in Article 5 to "disclosure."

(iii) Disclosure

Where the carriers provide enhanced services, they will know more than their competitors about plans for the evolution of the basic network. Accordingly, it may be less expensive for the carriers to provide enhanced services, and they may be able to introduce these services to the marketplace more rapidly than their competitors. It is therefore important for the carriers to provide information about network plans to enhanced service providers.

In Telecom Decision CRTC 84-18, the CRTC dealt with this issue. It concluded that competitors would receive sufficient network planning information through participation in construction program reviews and general rate proceedings. Given that Article 5 specifies "disclosure" as one of the remedies for anti-competitive conduct, it is doubtful whether the level of disclosure mandated by the CRTC is sufficient. Significantly, the "Report on ISDN Implementation in Canada", issued in March 1989, has called for disclosure of carrier plans on a timely basis.

(iv) Grandparenting

Generally the FTA is prospective. But, a careful reading of paragraph 5 of Article 1402, along with Articles 1403 and 1404, seems to indicate that, while rules and regulations relating to national treatment, and licensing and certification are grandfathered, rules and regulations relating to a different matter, cross-subsidization in the enhanced services market, are not. The better view would seem to be that the grandfathering provisions of Article 1402 do not apply to Article 5 of Sectoral Annex 1404 C. In this view, Article 5 of the Sectoral Annex is indeed meant to affect existing regulations. This would appear to be more in keeping with its requirement to introduce effective measures to guard against anti-competitive conduct.

(v) Collaboration between Regulatory and Competition Authorities

As well as concern for cross-subsidization, Article 5 speaks to predatory conduct and the discriminatory provision of access to basic facilities or services. Canada has thus far not had a happy experience co-ordinating regulatory and competition policies. What thinking there has been on this issue has been stunted by an extravagant version of the regulated conduct exemption. It is far from clear how the FTA can and will be used to augment existing provisions of the competition law dealing with price discrimination, predatory pricing, and the like.

(vi) Commercial Presence and Investment

Paragraph 2 of Article 3 of the Sectoral Annex provides for the establishment of a commercial presence which includes, "the establishment of offices, appointment of agents, and installation of customer-premises equipment or terminal equipment for the purpose of distributing, marketing, delivering or facilitating the provision of an enhanced or computer service." This does not appear to address what is emerging as a serious limitation on the further development of the enhanced services market. Current Canadian regulatory policy effectively prohibits the ownership and operation of any transmission facilities by non-basic carriers. There is room to doubt whether enhanced service providers could function effectively if they are not allowed to own and operate at least some of the transmission facilities utilized.

Given that the objective of the Sectoral Annex is to support the further development of an open and competitive market, there is room to argue that paragraph 3's statement that investment shall include the purchase of "equipment necessary for the provision of enhanced or computer services" should be stretched to cover a limited range of transmission facilities as well.

8. Lessons from the FTA

As the pioneering international agreement on telecom services, the FTA constitutes a significant, though limited, achievement in furthering regional economic integration. Although it was possible to build on a comprehensive bilateral private order relationship, fundamental differences with respect to facilities based competition (along with residual sovereignty concerns) meant that agreement had to be focused on enhanced services. This, in turn, requires domestic regulatory responses to implement international commitments to further develop competitive markets.

Viewed optimistically, one might conclude that much has been achieved in the face of fundamental obstacles; viewed less optimistically, one might be struck by how little has been achieved between two countries with such highly integrated telecom systems.

9. Towards the NAFTA

Negotiations are currently underway to expand the FTA to include Mexico in a new North American Free Trade Agreement (NAFTA). It would appear that the FTA's distinction between "basic" and "enhanced" will be maintained. Overall, the development of a new agreement requires that regional free trade concerns be placed in a broader international context; raises for Mexico many of the issues already dealt with in the FTA, and puts a critical searchlight on attempts by Canada to insulate its basic services from bypass to the south.

(a) The GATT Context

Ideally, NAFTA should be viewed as complementary to whatever eventually emerges from the Uruguay Round. Inconsistency must be avoided between regional and global environments. NAFTA should be more focused on specific issues and, as a separate regional agreement, should bind the parties to commitments additional to those negotiated through GATT. To achieve complementarity will require some shift in emphasis from national treatment to genuine market access with greater transparency in regulation.

(b) For Mexico

Appropriate new regulations will have to be developed to ensure that Telmex will not gain an unfair advantage in providing competitive services. Here much may be learned from Canada's experience with the FTA. However, unlike Canada, substantial standards questions will have to be addressed as well.

(c) For Canada

The most provocative question concerns regulatory decisions designed to keep Canada-Canada traffic on the domestic network and to protect Teleglobe's monopoly in overseas traffic. As these protectionist measures involve "basic services", they are valid under the FTA, although of questionable practicability given enforcement realities. However, it is argued that these decisions restrict cross-border access for basic services and also have an adverse overall impact on providers of value-added and information services. In any event, it is said that they limit the ability of service providers in one country to take advantage of lower cost facilities in another country.

As well as the "bypass to the south" issue, long-standing restrictions on the processing of banking data, and the need to yet further liberalize equipment approval procedures, have been raised.

10. Conclusion

It is evident that any discussion as to whether IT developments are more conducive to global developments or regional trading blocs, it will be necessary to keep the FTA (and now NAFTA) in mind to assess limits and opportunities for institutional measures concerning telecom to act as facilitators for regional and international economic integration.

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Tuesday, January 14, 1992

Working Groups

NOTES

MALAYSIAN TELECOMMUNICATIONS
Challenges, Strategic & Policy Issues And Opportunities

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ABSTRACT

The last five years was the most rapid phase in the telecommunications evolution in Malaysia. This primarily is due to the privatization of the telecommunications sector that coincided with the rapid economic growth period of the country. The Government's liberal approach has opened doors to a host of new business opportunities and has given rise to many new entrants into the telecommunications arena.

The eighties will be remembered as a decade of remarkable changes in the world of Telecommunications. The changes were the results of new political philosophy at the time when technology was developing rapidly. The pivotal events were the privatizations of the PTTs in various countries, including Malaysia.

The Malaysia experience in telecommunications is worth noting.
Chronologically they are:

1. The first telephone land line in 1874
2. The first telephone exchange was installed in Kuala Lumpur in 1891
3. There were only 21 telephones in Kuala Lumpur supported by some 400 miles of telephone and telegraph lines in 1895
4. The first submarine cable between Singapore (then part of Malaya), Labuan (then part of British North Borneo) and Hong Kong in 1894
5. The first international wireless station operating maritime frequency of 500 kHz in 1926
6. The introduction of Subscriber Trunk Dialling in 1962
7. The laying of SEACOM cable for international telecommunication network in 1964
8. The handing over of international telecommunication services and infrastructures from Cable and Wireless in 1964
9. The first international gateway through Satellite Earth Station in 1970
10. The first International Direct Dialling (IDD) to 4 destinations, i.e. U.K., Hong Kong, Japan and Australia in 1984
11. Modernisation into Stored Programme Control (SPC) in 1980
12. The introduction of data service in 1983
13. The introduction of telefax in 1983
14. The upgrading of International Maritime Service (IMS) in 1983
15. A company Telekom Malaysia was incorporated to take over the operations of Telecommunication Department as part of the Government's Privatization Policy in 1984
16. The Telecommunication Services (Successor Company) Act was enacted in 1985
17. The introduction of cellular radio service (ATUR-Automatic Telephone Using Radio) in 1985
18. The introduction of MARS (Multi-Access Radio System) in 1985
19. The introduction of Maypac in 1988
20. The use of International Business Service in 1988

Malaysia has seen in the last five the most rapid phase in the telecommunications evolution. This primarily is due to the privatization of the telecommunications sector that coincided with the rapid growth period of the country. The PTT in Malaysia was privatized on the 1st of January 1987 and the government retained the regulatory functions under the Department of Telecommunications.

Privatization were merely the appetizer and for more than 4 years, Malaysia has endevoured to develop its own regulatory principles, regulations and practices. The process is still on-going. The liberalization and privatization exercise has raised issues of management of change. Each nation has a different set of values, circumstances and priorities that dictate the nature of the changes and the rate at which they occur. In Malaysia, the Telecommunications Acts sets the framework for the regulation of telecommunications in the country. In the act it confers upon the government the exclusive privilege of establishing, maintaining and working telecommunications in Malaysia. As a corollary to the concept of exclusive privilege, the Minister charged with the responsibility for telecommunications may grant licences to any person.

The authority recognised the need to spell out the future competition policy to take the telecommunications Industry all the way to the year 2020. In charting the future competition policy for basic services they have taken into consideration the following factors:

a) The size of the present network
b) Technologies that are being developed
c) Economies of scale
d) Duplications of resources and networks

The authority has taken a stand that for the basic services, after taking the above factors into consideration, the most viable form of competition would be to use the wireless technologies to compete against the wired network or the existing monopoly.

For the non-basic services, including value added services, the policy will be to promote competition and to remove barriers to market entry in order to increase the variety and quality of services available to the consumers. They feel that these services will promote the formation of the so-called "Information Society" and also provide a competitive edge to the industries.

The question of whether effective competition will take place in a manner that is beneficial to the consumers will depend highly on the policies adopted by the authority. The promotion of a liberalised, competitive environment will certainly speed up the rate of change. The dynamism is an important factor to the national economy and the authority, such as the Regulator is explicitly obliged by law to further develop and improve by creating investment strategies for a future-oriented and efficient telecommunication system. The Malaysian Government has already developed a certain investment incentives to create a conducive atmosphere for telecommunication industry. The incentives, among others, are:

1. Government has accorded priority status to the development of telecommunication sector
2. Encourage local manufacturing for internal use as well as export
3. Flexible equity guideline
4. Government assistance to foreign investors
5. Tax incentives
6. Infrasturcture/utilities: reduced rate of overseas telephone, fax, telex and electricity bill
7. Expatriate personnel: transfer of technology
8. Other key factor included liberal foreign exchange controls and free repatriation of profits, efficient commercial banking facilities, a pool of skilled, cost-efficient and productive labour, economic and political stability, industrial harmony and last but not least quality of life in Malaysia

The Government's liberal approach has opened doors to a host of new business apportunities and has given rise to many new entrants into the telecommunications arena. It has gathered momentum over the last few years and is now a very dynamic industry. The dynamism is expected to accelerate in the near future, astrude with the other developmental activities in the country, to achieve the nation's Vision 2020.

VIEWS

The forces of change and policy response by authority should be considere form the common factors such as:

1. Development of National Telecommunication Policy

They have been a dramatic industrial restructuring; computers and telecommunications are merging. Falling costs due to advances in microelectronics, fibre optics, software and digital technology have driven the technology towards an integrated system such as ISDN. Value Added Network (VANs) are being introduced as evident of divestiture of the monopoly industry.

2. Liberalization or monopoly

It is clear that telecommunication services have grown from the plain old telephone services to new services such as data communications. Basic telephone service so far has been comfortable monopolized by PTT or single government company. With more widespread use of information and data, telecommunications service provider has to contribute huge investment to satisfy this new demand. The reasons are inevitably due to:

- o growth of world trade
- o diversification and specialization of world production
- o partial substitution of goods exports with manufacturing in key markets, as countries try to increase the "local contents" part of goods sold in their market
- o increase in world travel and tourism
- o greater availability of similar services around the world, such as financial, travel and hotel services
- o operations of multinational corporations which increase their international computer communications
- o and so on

Thus the choice of enhancing growth is either harmonizes regulation or liberalization.

3. Standardization and Technical Approval

Standard and technical approval must be available timely as the demand for world-wide user and the uses of newer technology are increasing. The strategy of adoption must be based on world-wide user interfaces and access, transparent transmission and ease of migration.

4. Consumer Premises Terminals

Consumer Premises Terminals (CPT) are contributory to the growth of the telecommunication services. By having an open market down stream fair competition must be observed and the regulatory function by the authority must be exercised to maintain this healthy competition.

5. Value Added Network

Another "grey area" in telecommunication service that need to be addressed clearly. Value Added Network (VAN) must be strategically defind within a known network boundary. The demarcation must be clear between the Public Switching Network and the Value Added Network.

6. Tariffs Structuring

Tariffs structuring must be strategically adjusted to the evolution of the services available. Structure must be available for, as an example:

- o bearer service
- o connection charges
- o subscriber fee
- o administration charges
- 0 utilization charges
- o etc

GLOBAL STRATEGIES : VISIONARY TELECOMMUNICATION APPLICATIONS
THE OLD ORDER CHANGETH
PRIVATE AND PUBLIC SECTOR POLICY DIRECTIONS

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Digital information processing and telecommunication are driving, indeed forcing change in how business is conducted and how society progresses. Such digitalisation is driving rapidly internationalisation and globalisation which demand more competitive environments and improved economic performance if nations are to enjoy prosperity from this decade.

"What Hath God Wrought" was the message Samuel Morse sent in 1844 from Baltimore to Washington, barely 60 kilometres away. Since that first telegram which was, in reality, the first form of digital application electrically transmitted the marvels of telecommunication have never ceased.

Telegraphy was overtaken by telephony and, until recently, digital transmission by its analogue counterpart. This is all changing, thanks to the progress in electronics initiated a few decades ago by the transistor and advances in semi-conductor technology, wide-band transmission techniques, including laser applications and a host of other breakthroughs which enable the integrated application of technologies; all aided by the convergence of computing and telecommunication processes.

Developments already in train will substantially add further revolutionary changes. ISDN (Integrated Services Digital Network) concepts and IN (Intelligent Network) advances will bring unprecedented opportunities for real-time and integrated system (switching) intelligence applications, as distinct from stand-alone data banks and the like of today. The 1990s will also bring unprecedented mobility and convenience. Users will have the opportunity of trade-offs between processing, assembling, reassembling and transferring information through their stand-alone equipment and chosen centres of operation within the network(s).

This will create significant customer/service supplier partnerships. The customer will become a dominant factor for this decade.

Many of the current differences between private and public (PSTN) networks will also be obliterated in favour of similarity and interaction.

The restriction of the traditional tie to wire line communication between fixed points will be eliminated. Further, progress will evolve in cordless and tetherless apparatus, stations and terminals which will be connected together by high quality wireless local area networks (LANS) and PCN systems. In effect, quality and flexible digital connectivity will be available at low cost through advanced radio communication techniques.

Digitalisation will also bring greater reliability, quality, huge band-width capacities, low cost operation and important economies of scale. Distance becomes largely irrelevant. Coincidental will be the natural flow for end-to-end connection, as telecommunication takes on the shape of integrated software-driven operational functions.

Today's telecommunication systems are, in reality, species of information systems supported by integrated digital technologies. Other adjustments follow.

First, connectivity and networking have put a new-found emphasis on standards for interconnection and harmonisation of actions nationally and internationally. International institutions like the ITU, the ISO and the IEC, as well as the national and regional standardisation bodies, particularly those of the industrialised world are involved with structural adjustments and process reforms.

Digitalisation has provided means to transform dramatically the telegraph and telephone to a sector with major opportunities for improved efficiency and across-the- board economic performance throughout all sectors of the national economies. Significant benefits are available for those who understand and seek to participate in the current waves of internationalisation and globalisation in industry, trade and commerce.

Telecommunication is now increasingly accepted as one of the major pillars for national, regional and global competitiveness and economic performance. Accelerating changes are being forged not merely by technology and innovation, but also as a result of the opportunities for new infrastructures, entrepreneurial service providers and user requirements across all sectors. Avenues are more pluralistic. Choice at affordable prices is increasingly being sought for the wider competitive benefits.

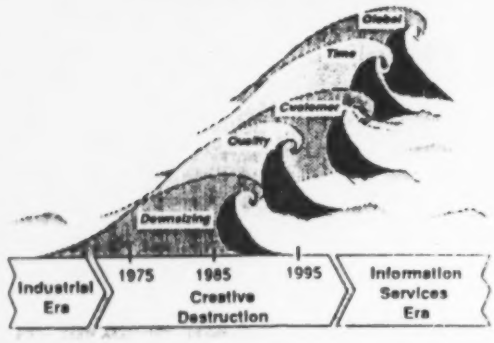
These revolutionary advances are forcing the current waves of globalisation. Organisations are restructuring the way in which they function across the whole spectre of the economy.

Competitiveness is no longer dependent upon where organisations, institutions and persons work, but how they optimise the new found network connectivity; and, in turn, whether they manage knowledge - human and material - effectively.

In the 1990s emphasis will shift from downsizing and cost savings to the servicing of improved quality, customer needs and of shorter time schedules for innovation and service delivery. They are key requirements for successful participation in the growing internationalisation and globalisation (Figure 1).1 The next decade will see the global wave crash over us.

It is interesting to note the alliance or similarity of this evolution with the progress in information technology moving from the data processing DP era (Figure 2).2 It is against this background that organisations will be transformed, and particularly those who wish to survive into the future and share the benefits of internationalisation.

The Next Decade Will See the Global Wave Crash Over Us



We are just entering the frontier in our understanding of this phenomenon

Figure 1

Such revolutionary developments lead naturally to reflection and action on the elements and attributes to be transformed in the movement to a "transformed business" (Figure 3).3 These are the indications of moving from functional hierarchies to networked hierarchies with an emphasis on the knowledge worker and greater flexibility. They change the way multi-nationals function. Greater attention will be paid to local identity, but strapped together in significant information systems dependent upon public and private telecommunication networks enabling strategic alliances.

Collectively, These S-Curves in Organisations Underlie the Economic Transition

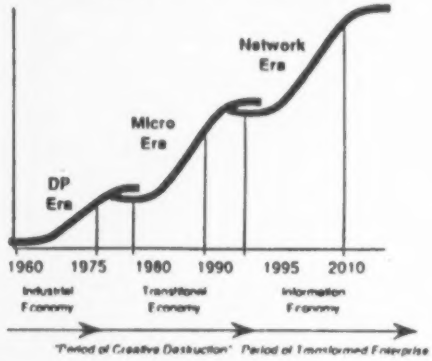


Figure 2

Figure 3

Traditional concepts of vertical hierarchy, control spans and long lines of command will be pushed aside. The movement in conceptual requirements of a global company is poignantly described in Figure 4. The same mindset objectives are equally relevant to those with a domestic and regional aspiration.

Telecommunication is playing a key part in such transformations. It is partnering sectoral support with the necessary financial and transport services5 in an era of growing accent on free trade and services.

Telecommunication processes now provide the opportunity to optimise the full capabilities and role of information systems to serve the visionary global or international mindsets of those who wish to proceed and prosper into the new information services era.

So, having contributed to major adjustments in change in organisations, structures and in user applications, it is inevitable that there will be huge growths in service applications which can only be satisfied effectively by unprecedented growths in telecommunication services.

Thus, the issue is the extent to which individual nations have the will to rise above the self-centred and short term issues and elaborate nationally long-term strategies to optimise the opportunities. It is a question of moving well beyond the generalities of confusing and superficial expressions such as "liberalisation", "deregulation", "privatisation" and "competition", often coupled with asteric phrases which may breed complacency.

The real issues are the provision and utilisation of advances for appropriate productivity, accountability and reasonable competitiveness to participate world wide, optimising the strategic advantages that lie in the current waves of change, assuring the greatest benefits with the least practicable and competitive cost, consistent with national social and economic goals in the broader sense.

Telecommunication policy must have recognition of its multi-dimensional characteristics. Policy must go beyond cost competitive service infrastructures. It must consider all elements of national industry and licensing policy considerations - otherwise the trade and service balances will be decimated.

The words of Alfred Tennyson, a contemporary of Morse, now come well to mind "The old order changeth giving place to new". The many ways in which the poet saw the fulfilment of his world, will surely be true to the telecommunication scene as it moves to the 21st century.

The challenge is to activate adequate will - political and wide ranging but effective visionary mindset policies which encourage the appropriate investments and competitive service infrastructures with necessary freedoms for innovation and technology change with the widest industry objectives. Regulatory intervention should be confined to assisting the process of fair and reasonable competition between the competing service interests.

Figure 4

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Electronic Data Interchange (EDI): Environmental Issues and Organizational Considerations

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Electronic Data Interchange (EDI) is inter-organizational exchange of business data in a standard format. Typically EDI provides productivity gains at the operational level of an organization. EDI also bears strategic implications for a company's business. However, benefits of EDI may not be substantial unless EDI is integrated with the company's internal applications and participating parties are in agreement. Eventually, EDI can affect relative relationships between companies, resulting in changes in the industry structure. Principals and agents, and vendors and buyers linked by EDI may expect a new business relationship in the future. This study explores intra- and inter-organizational issues in EDI adoption.

1. Introduction

Ford Motor Company is upgrading its Supplier Online Management System so that 3,000 suppliers will electronically communicate shipping information. Instead of sending information in batch at the end of a shift, notifications will now be transmitted as soon as parts are shipped. "With the batch system, the truck carrying the parts would sometimes arrive before we received the shipping notice," says the Director of Information Systems [Stix, 1985].

"The EDI market... is growing at a staggering rate of 88% annually. The market will leap to $1.9 billion in 1992" [Belitsos, 1988]. "It shows 56 percent average annual growth rate and the user base will jump to more than 22,000 by 1994" [Beckert, Knill & Rohan, 1990].

Electronic Data Interchange (EDI) is the inter-company, computer-to-computer communication in a batch or online mode of standard business transactions. The information is in a standard format agreed upon between trading partners and are transmitted through direct links or by a third-party vendor. The information is transferred electronically so that the need for rekeying by the receiver is eliminated. The transferred information can be integrated seamless with other internal applications. EDI is capable of also communicating non-standard information such as computer-aided design/computer-aided manufacturing (CAD/CAM) graphic documents.

The benefits of EDI that are often cited include reduction in paperwork, errors, lead time, and inventories. However, many of these benefits claimed are based on anecdotal evidence and prescriptive in nature.

"While EDI enthusiasts are quick to point to reports that a full 50 percent of the Fortune 1,000 companies already use EDI in some form, they seldom mention one additional fact: About 90 percent of those users are in the pilot phase (as of 2/89) of setting up EDI systems" [Joyce,

582

1989]. One consulting firm conducted a recent survey of over 500 EDI users showing 65% had EDI connections with fewer than 10 trading partners and 66% were using EDI for less than 10% of business documents [Bradford, 1990].

International paperless trading activity is minimal. The experts on this are the telecommunications networks. Since they make their living moving messages, they should have a good take on what's happening. They report traffic levels ranging between slim and none [Seideman, 1990].

Do little thinking about the potential benefits (of EDI) to them....They tend to see only the expense. For companies with low transaction volume, it can be hard to justify the up-front cost of retraining clerical workers and integrating with their applications. They end up faking it, using a personal computer. Indeed, after receiving EDI documents, suppliers often print them out and distribute them as they have always done [Belitsos, 1988].

A major auto company was at least 18 months behind schedule in implementing its proprietary EDI network [Stix, 1987]. One EDI consultant stated that a client had hoped to have EDI implemented with fifty trading partners at year-end, but instead had connected only two [Joyce, 1989].

These anecdotes also demand us to examine underlying issues that hinder companies from successful application of EDI. In fact, it would be useful to find post-implementation evaluations of EDI by representative companies. Published literature yield little examples of this type of analysis. The lack of this specific information is partly due to its confidential nature. Also, were such information to be published, it would be biased towards a favorable result.

What are real issues in the adoption and application of EDI? How a company can best utilize EDI opportunities to maximize benefits? What are the long term implications of EDI? How do companies adopt EDI? Does EDI affect the intercompany relationships? Environments for EDI adoption may be different for different industries and different applications. Size of the firm, company's familiarity with information technology, market structure may require different perspectives for different cases in the application of EDI.

This study is motivated by these questions and lack of systematic EDI research published. The paper aims at exploring questions such as: What are issues in the application of EDI? What are impacts of EDI? Will EDI affect relationships among companies? Rather than providing the microscopic analysis of a detailed issue, the study offers an opportunity to overview potential concerns related to EDI.

The paper is organized as follows: First, EDI applications and operational gains are introduced. The environmental issues and organizational considerations are described next, followed by a conclusion.

2. EDI Applications and Operational Gains

Opportunities for applying EDI can often be found in companies operating under a large volume of repetitive transactions, a tight operating margin, strong competition requiring productivity improvements, time-sensitive environment, and companies to which EDI implementation have been requested by a large trading partner [Emmelhainz, 1989].

EDI is typically applied to standard business processing such as inventory management, check processing, automatic teller machine, point of sale, electronic fund transfer (EFT), order processing, stock trading, and tax filing. Non-standard engineering CAD/CAM drawings also utilize EDI. CAD/CAM data transactions are bulky, complex, long-lived and expensive to generate while commercial EDI transactions are relatively brief, simple, short-lived and cheap to produce. However, such high cost and longevity of CAD/CAM product data can point to their strategic importance for companies [Shaw, 1990].

Further, the sharing of information (demand schedules, for instance) with suppliers, co-design, and open communications can lead to a long-term, low-cost producer market position. Close ties with customers can be beneficial: An EDI participant is more likely to address customer needs in an effective and prompt manner [Dearing, 1990].

At the operational level, reduced paperwork and clerical effects is a major contribution of EDI. Delays associated with mailing, processing time required for an order entry clerk, buyer, accounts payable clerk, etc. to read and reenter data can be eliminated. Since the data are not repeatedly rekeyed, probabilities for making errors can be lowered. Thus, EDI reduces personnel costs through elimination of redundant rekeying, manual reconciliation, reduced time spent correcting errors, and freeing professional personnel from administrative tasks [Snapp, 1990] [Boudette, 1989]. Since administrative lead time can be reduced, the use of CAD/CAM EDI can expedite the research development cycle for new products.

The speed inherent in EDI can be compared to the common alternative of postal delivery. Even overnight mail cannot be compared with EDI's promise to have messages received within minutes. This increased speed along with its reliability is essential to just-in-time (JIT) inventory systems.

However, benefits come later, may not appear significant until experience is gained in the technology, and might not appear to be very substantial until EDI is integrated with other internal applications. Quite often, start-up costs need to be capitalized to derive the long-term benefits.

3. Environmental Issues and Organizational Considerations

This section explores potential issues related to successful implementation and application of EDI for a company.

In-House Development versus Out-sourcing

Due to the increasing capability and declining cost of EDI software, it may be less advantageous for a company to develop its own software. However, the decision should be based on the nature of applications, in-house resources, maintenance required, and company strategies [American Management Association, 1989].

Standardizing Inter-Company Document Formats

This task is performed within the company by bridging software. Quite often the standards do not specify which code (for instance, seller's catalog number, buyer's part number, etc.) should be used. These decisions are usually left to the trading partners to decide. Before accepting EDI, a company must decide to unify under one standard any incompatible "nomenclature, definitions, and document formats" within the company and attempt to standardize.

Integration with Internal Applications

In implementing EDI, applications at the department and the company levels as well as at the industry level should be considered since it is often likely to under-estimate the time and effort needed to implement EDI with trading partners.

In an EDI system, information has to flow beyond being printed out. For example, it can automatically come from material requirements planning (MRP) systems and be fed into manufacturing systems. These benefits, however, can be the greatest cost of implementing an EDI program. Thus, in many cases, applications may need to be retooled to generate or process EDI data. This process of integration is frequently achieved by a process called mapping. EDI mapping is time-consuming and complicated because multiple databases and trading partners' formats are involved.

Further, integrating the EDI software into the internal data processing system is an important consideration. Revamping the in-house system to allow it to talk to an outside system requires a considerable mental leap.

Inventory Control

Typically EDI is considered resulting in better inventory control, turnover, and reduction of safety stock. However, in some cases suppliers may have to hold more inventory under EDI rather than actually decrease the level of inventory, since expectations of rapid delivery have been raised [Stern & Kaufman, 1985].

Loss of Float on Payments in EFT

EDI involves the loss or decrease of financial float--the time between when an invoice is received and when payment is due. The receipt of prompt payments made possible by EDI through EFT directly benefits the company's true cash flow, reflecting net change in balance sheet accounts having cash inflows and outflows. While the cost effectiveness of EDI may be greater than the amount of money ever earned on float, small companies with limited potential of achieving EDI benefits, and an absence of customer pressure to implement EDI, may be better off scrapping EDI and retaining float [Joyce, 1989] [Medford, 1990].

Control of EDI Processes

As paper documents become obsolete, so do the conventional audit trails. The EDI implementor must be aware that new controls should be designed to assure the integrity of financial data. A control mechanism needs to access multiple application software and routes the transaction to the proper module, sending invoices to accounts payable and payments to accounts receivable [Hill, 1987].

An important control question concerns the consequences of the termination of an established EDI relationship: What costs or security risks may be involved? If a large company has incurred expenses in installing an EDI system with a smaller partner, how would these costs be accounted for if the relationship ends? What about confidential information of the partners once the relationship ends?

User Acceptance of EDI

Non-quantitative feedback is also important. Are employees accepting the new system? Is operation of the new system smooth? Are trading partners making favorable comments about the new system?

Legal issues

Legal aspects of EDI may still be unclear yet. Apparently EDI lacks legislative prescriptions and case law precedents. For example, users may be engaged in EDI without the benefit of signed agreements: What is expected of each party? Who is liable if a transmission fails? Can the interchanges themselves result in legally enforceable contracts?

Security Issues

The data being transmitted are vital business records. This concern has inhibited many companies from using a value added network [Stix, 1985]. Lack of hard copy, authorization and limited access, tracking data, authentication, and encryption should be considered [Sokol, 1989].

Company Relationships in Industry

Since control in trading partner relationships is usually exercised by a large purchasing company over its small suppliers, many large "hub" companies may require their suppliers to be a specific EDI-capable. EDI implementation naturally leads to a reduction in the number of vendors a company does business with, as partners are sought who are also EDI-capable. Between hub

companies and suppliers, EDI investment may turn out to be a switching cost which affects flexibility of a company in changing business partners.

Even if the hub company does not dictate EDI implementation, survival may still be at stake in a competitive industry facing low profit margins. However, the cost of developing EDI systems may not offer strategic flexibility to small companies. Further, the standard issues may also affect the decision flexibility of later participants of EDI.

Timing of the participation in EDI may have different implications for a company's competitive strategies. Eventually, EDI may become a way of doing business and a necessity much like telephone [Benjamin DeLong, & Scott-Morton, 1990]. Thus, what is essential for doing business may not yield a competitive advantage [Clemens & Kimbrough, 1986].

One factor that should not be ignored in making this decision is whether it is believed that a "critical mass" of EDI-participants has been reached, on either an intra-industry, cross-industry, or international basis, that will make implementing EDI worthwhile. Another factor is that economies of scale can be somewhat overcome with EDI. Value of participating in EDI may increase or decrease as the number of participants changes because participants may be able to differentiate themselves being a member of a specific EDI for a certain period of time.

4. Conclusion

Despite considerable excitement on the application of EDI in praise of efficiency gains and strategic implications, there are many issues that need to be discussed about its successful applications. In this study, an attempt is made to identify intra-company, inter-company, and cross industry issues in EDI adoption and applications. Especially, impacts of EDI on the company and the industry are still unclear and need further investigations. The future research aims at testing a variety of aforementioned EDI issues.

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Recent Commercial Developments in the New Zealand Marketplace

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1. ABSTRACT

Telecommunications deregulation has gone hand-in-hand with privatisation. Deregulation has been necessary to enable privatisation to occur. Privatisation has been a means for governments to raise revenue, while making previous monopolies more efficient. There is a fear that new owners may exploit actual or a lack of legislation for their own ends. Deregulation has opened up competitive opportunities for new service providers and equipment vendors in New Zealand.

2. BACKGROUND

In the early 1980's the New Zealand Post Office's ability to operate as an effective monopoly telecommunications network provider was diminishing. Shortages of capital and skilled staff, contradictory objectives and confused management structures severely eroded the efficiency of its telecommunications activities.

On 01 April 1987 Telecom Corporation was established to undertake the telecommunications trading functions of the old Post Office. Regulatory functions including radio spectrum management were transferred to the Ministry of Commerce. An in-depth analysis of the regulatory environment for telecommunications was undertaken by Touche Ross for the Government to establish the viability of competition in a deregulated telecommunications environment. Deregulation began in 1987 with the first area to be deregulated, the provision of building cabling, to be followed shortly thereafter by customer premises equipment (CPE). Full deregulation followed in 1989 with the opportunity for competition in any area of telecommunications.

In September 1990, the sale of the former monopoly, Telecom New Zealand to Bell Atlantic and Ameritech for NZ$4.25 billion was completed.

3. REGULATION

3.1 LEGISLATION

The Commerce Act 1986 - In setting up deregulation the government intended to create an environment which would stress competition in normal business practice, in preference to regulation and state intervention. It is the Commerce Act which ensures that anti-competitive behaviour is not undertaken by a dominant player in the marketplace.

The Fair Trading Act - This Act has no particular reference to telecommunications services, but is intended to govern the day-to-day activities of any trader in the New Zealand market. Particular applications to which it applies, are for example, in the area of misleading advertising.

The Telecommunications Act 1987 - This Act regulates the supply of telecommunications services in New Zealand, and covers a wide range of areas including offensive language and the disturbing use of telephones, monitoring of calls, regulation powers in respect of international services, and information disclosure. It also establishes the powers of network operators, and allows any network operator the right to access land, lay cable, and negotiate with land owners for the same access rights as Telecom received by statute.

The Radio Communications Act 1989 - A system of the tradable property rights for radio spectrum, based on **MANAGEMENT RIGHTS** and **LICENCE RIGHTS**, was introduced in this Act.

3.2 REGULATORY BODIES

Ministry of Commerce - The role of the Ministry of Commerce is to "increase the prosperity of all New Zealanders by promoting a commercial environment which encourages the fair and efficient operation of markets and efficient competitive business".

The Secretary of Commerce can decide standards for radio communications equipment, interference levels for New Zealand, management rights to radio spectrum, and can obtain the relevant Telecom contracts to see that the information disclosure regulations are adhered to. The secretary is also responsible to advise Ministers of the Crown on effective policy, and to ensure that policies are consistent with Governments' overall competition and general policy objectives.

Commerce Commission - The Commerce Commission is an autonomous body set up to enforce the Fair Trading Act. The Commission has the power to obtain from any person, information it believes will establish whether the Commerce Act has been contravened. The Commission can also engage experts to assist in its enquiries.

3.3 FALLBACK OPTIONS

Reregulation - The Government contends that if any two parties competing with each other in

telecommunications cannot reach agreement on particular points, then they should take their differences to the Court where the Commerce Act and general competition law will act as adjudicator.

The back-stop that the Government is quite prepared through intervention to resort to tighter regulation if required. Similarly, the Government is prepared to rescind any part of the present regulatory framework, if it is convinced that the measures put in place are not contributing to the objectives of free competition. It is the Ministry of Commerce, who would advise Government on such matters.

Mediation - Some industry commentators in New Zealand maintain that mediation or arbitration is preferable to regulation. The particular example most often cited is interconnection negotiations between competing carriers. Government has put forward a proposal that all communications should be transparent to the users, and that there should not be any particular barrier to people being able to choose which carrier they wish to use.

4. COMPETITION

4.1 CLEAR COMMUNICATIONS

Clear Communications Limited is a company comprising the shareholders, Bell Canada International, MCI International, Television New Zealand Limited and Todd Corporation of New Zealand. Clear Communications provides long distance (toll) services in competition with Telecom Corporation. The Clear Network uses microwave telecommunications links owned by Broadcast Communications Limited, a subsidiary of Television New Zealand Limited, and it also leases two fibre optic cables from New Zealand Rail Limited between Auckland and Wellington. Further capacity is provided through the lease of fibre optic cable capacity between Wellington and Christchurch from Electricity Corporation of New Zealand Limited.

Clear Communications interconnects with Telecom Corporation at 13 points, enabling users to originate calls to the Clear Communications Network. Approximately 82% of telephones in New Zealand have access to the Clear Communications' services. Clear also provides international services via its interconnect agreement with Telecom, as well as a leased digital service.

Users currently access Clear's national toll service by inserting the digits "050" in front of the national telephone number. Once Clear Communications is able to establish an overall market share of 9% of the national call minutes, then Telecom New Zealand has agreed that they will start negotiating for equal access. It is anticipated that negotiations will commence in early 1992 to give Clear access to the Telecom network without the use of "050".

Interconnect has proved to be a major stumbling block in the connection of new customers to Clear's gateway service. Clear was awarded a contract to provide the Justice Department with a basic telephone service, but due to interconnect problems with Telecom Corporation, the matter was taken by Clear to the High Court. The judge declined an application for an interim injunction, and told the parties to continue negotiations.

Telecom is requiring Clear to dial an access code in addition to a seven digit subscriber number. Furthermore, Telecom wants to charge callers who dial the Clear network a differential tariff at a premium. This will mean that callers would pay a standard Telecom rate plus a surcharge to dial the Clear network.

4.2 BELLSOUTH

Bellsouth was awarded rights to the use of the TACS A spectrum in 1990. Bellsouth is proposing to introduce a new cellular network to New Zealand using GSM technology based on the digital cellular techniques which are currently being introduced in the Pan-European network. The proposed digital system is expected to provide commercial service in Auckland in early 1993 and would compete with the existing Telecom New Zealand analogue cellular network using the AMPS B band.

Bellsouth is currently undertaking interconnection negotiations with Telecom New Zealand, and some difficulty is being experienced regarding the provision of billing and collection services on reasonable contractual terms from Telecom.

At this stage, there are no benefits of competition being derived from cellular services in New Zealand.

4.3 VAN / VAS

A number of new Value Added Network or Value Added Service providers have emerged in New Zealand since deregulation. One of the earlier entries to this market was Netway Communications Limited, a joint venture company formed by Telecom New Zealand and Freightways. Bulk bandwidth is purchased from Telecom New Zealand, and resold through a value addition process. Both data, and voice services are provided by Netway. Through the provision of specialist applications, Netway provides services to customers which are largely non-competitive with Telecom New Zealand's services.

A number of smaller niche market suppliers have also sprung up, but these offer limited competition to Telecom, because they are reliant on the provision of bulk bandwidth by Telecom.

4.4 EQUIPMENT RESELLERS

existence."

The rather robust form of legislation has proved so far to be more of a damp squib. It is not surprising that Clear is doing everything it can possibly think of to maximise its distance from Telecom. (10)

Litigation is currently under way in New Zealand on the following cases relating to telecommunications:

- The Commerce Commission investigation of allegations of overcharging on Telecom's megaplan (high speed digital transmission). services now under investigation for more than two years.
- Telecom's appeal to disallow its purchase of the AMPS A radio spectrum, one year since licence rights were awarded to Telecom.
- Various cases relating to interconnection with Telecom's services brought by Clear Communications, and Bellsouth. These vary from the assignment of specific access codes for interconnect, and exchange codes for the provision of Centrex services.

There are also several cases of a lesser nature where Telecom has taken action out against other parties for the use of unfair practises.

8.5 VENTURE PARTNERS

For new entrants wishing to join forces with parties who already have an existing telecommunications infrastructure, the opportunities are limited. Although parties like Clear Communications has established relationships with Broadcast Communications Limited (BCL), New Zealand Rail Limited, or Electrocorp, where the business of a new entrant would be non-competitive with Clear Communications, there is no reason why some arrangement could not be made. George Newton, the CEO of Clear Communications is on record as saying they would entertain "a strategic alliance with somebody who has already taken the risk" (9) in order to get into the cellular mobile business.

There are of course opportunities for new entrants to enter into relationships with both Clear Communications and Telecom New Zealand.

8.6 LOCAL SUPPOR

It is cost effective for any organisation contemplating setting up telecommunications operations in New Zealand to take advantage of local support. This could range from the initial business or marketing studies, applications for licences, identification of venture partners, liaison with Ministers / Ministry of Commerce / Commerce Commission / Telecom New Zealand / Clear Communications etc, arranging local finance, public relations, monitoring of market trends and changes, recruiting of personnel and training of expatriates.

Local knowledge on the customs, market, political structure, and the availability of other resources in New Zealand can be particularly beneficial to a new organisation.

With the downsizing of Telecom New Zealand, there is now a surplus of qualified telecommunications engineers and technicians in New Zealand. These people have proven to be particularly adaptable in taking on the challenges required to establish new telecommunication ventures. Given the right level of management supervision, this is often the most cost effective way of installing new telecommunications systems.

9 WORLD TELECOMMUNICATIONS LABORATORY

9.1 OBJECTIVES

The New Zealand Government has considered the opportunities for New Zealand to do more than just wait for international developments in communications technology. The concept that the Government is exploring is:

"New Zealand becoming an international centre of excellence in information technologies and interactive communications, thereby enhancing economic advantage and international competitiveness." (11)

The Government has asked a number of officials including the Chief Scientist of the Ministry of Research, Science and Technology, to prepare a study into the world communications laboratory concept to address the following questions:

- how can the WTL concept best be aligned with other government initiatives?
- what use of advanced communications and information is already occurring in New Zealand?
- what new communications and information technologies are becoming available which the New Zealand Government and private organisations can exploit?
- what obstacles or costs are there which might limit the introduction of these technologies?
- what areas of policy or regulatory issues need to be considered covering access to, and availability of, information which may be relevant to the successful realisation of the WTL concept?
- what role might government usefully play in promoting further exploitation of opportunities?

9.2 NEW ZEALAND'S UNIQUE POSITION

It has been previously commented that the relatively small size of the total New Zealand market may be regarded as a discouragement to investment. However, this small market may actually be one of the attractions for companies wishing to trial applications. The basic concept is not new, as there are analogies with the "First Cities" project being sponsored by Kodak, Corning, Bellcore Laboratories, Paramount, Apple

opportunities available in New Zealand, for example in directory services, or particularly in the provision of value added services.

It is perhaps the information area which will have the greatest impact on telecommunications in New Zealand. Electronic data interchange (EDI) has long been vaunted as one of the major advances of the information age. Although overseas experience is mixed, in New Zealand, the Department of Customs and private sector customs brokers have already developed an EDI system to facilitate the processing of imports and exports. The system reduces the time for processing imports from 5 days to 4 hours. In some cases, goods can be cleared through Customs before they have even left their source country. The EDI system could cut almost 2 billion dollars from the cost of New Zealand's imports and exports, and remove a substantial disincentive to foreign trade (5).

Other possible opportunities exist for the provision of information services in New Zealand. In the United States, newspaper publishers are fighting a move that would see the 7 former Bell system companies establish an advantage over newspapers and other information providers by using their telecommunications networks to transport information.

Peter Troughton, Telecom New Zealand's Managing Director, believes New Zealand has the potential to take strong advantage of the burgeoning international consumption of software. Software consumption, Troughton says, quadruples every year a trend likely to continue for the foreseeable future. Suggesting that New Zealanders have just the right characteristics to make them outstandingly efficient and effective software developers, Troughton states that New Zealand could become "The Software Factory of the World". New Zealanders, he says, are renowned for their creative problem solving ability, innovative thinking, versatility and their general competence, characterised by their ubiquitous "do it yourself" approach (6).

Indeed, TSSC, (a Telecom subsidiary company) has been operating in the area of software development for the NEC NEAX exchanges for some six years with a high degree of success.

8.2 DOMINANCE

Some commentators have considered the dominant position of Telecom and the relatively small size of the market mean that the full benefits of deregulation, which would apply in larger markets with more diverse market participants, will not be experienced in New Zealand.

Although New Zealand is a small and relatively isolated market, its ties with Australia through Closer Economic Relations (CER) offers the investor in New Zealand a springboard to Australia. There is currently a harmonisation of business regulation between Australia and New Zealand, and many Corporations are aligning market strategies for both Australia and New Zealand. There are however still significant differences in the telecommunication regulation between the two countries.

Several issues are currently being tested in the courts in New Zealand. Telecom's rivals are keen to access the 1.5 million names and addresses provided to Telecom for telecommunication services. This would allow Telecom subscribers to use Telecom's rival services without having to explicitly apply for them. In addition, controversy over the ownership of the national numbering plan abounds. The Ministry of Commerce has sought comments and submissions from interested parties on the numbering plan to ensure that a more coordinated approach to numbering is established, to foster competition. These submissions closed on 10 December 1991. The outcome of the investigation is still awaited. The report concluded that Telecom owns the National numbering plan but does not have the right to allocate all the numbers, and that Telecom had bought the right to its own telephone numbers when it established the State Owned Enterprise in 1987. However, Telecom does not have the right to allocate numbers to competitors, and if there was evidence that competition was blocked or severely diminished by numbering issues, the Government could legislate on the issue.

Other matters of dominance are fully addressed by the Commerce Act and the Fair Trading Practices Act.

It is no secret that both Telecom and Clear have spent substantial sums of money on legal issues, $100,000 spent by Telecom relating to local loop problems alone (7), and Clear Communications state they would be that looking at close to six figures (8).

8.3 REGULATION

Many of the questions relating to regulation revolve around the question of dominance. Presently many of these regulations are under test in the Court. As "regulator" of the "deregulated" telecommunications industry, the Government hovers in the background, ready to intervene only if necessary (9).

8.4 LITIGATION

John Crook, advisor to Telecom Managing Director, Peter Troughton in the September edition of the North American Telecommunications magazine TEM, stated "there is no regulatory agency in New Zealand making up rules about who can connect and who can do what, and what lines of business we can be in or not, although we do have a rather robust form of anti-trust legislation, which stops dominant companies from using their position to crush the competition out of

prices by more than the increase in the consumers price index. Telecom is concerned about market share erosion being caused by Clear, and they are claiming that the profit of the Regional Operating Companies is being unreasonably affected. There is a case under the kiwi share to raise standard residential charges above the consumer price index figure if Telecom can demonstrate that their profit has been unreasonably affected. At this stage there has been no decision to approach the Government on these grounds.

Telecom maintains that cross subsidisation still exists to the Telecom local loop, and estimates this to be $250 - $300 million per year. Although it could be maintained that in the sale of Telecom the new owners should have made provision for the level of cross subsidisation, Clear have made it known that they are not averse to contributing towards this cross-subsidisation.

Clear's pricing of leased circuit charges are typically 10% below the advertised rates of Telecom. During the last three years there has been a 50% reduction in the leased circuit charges by Telecom, made up in a variety of ways.

Telecom is also offering customers a "Memorandum of Agreement." Under these agreements, customers are offered a discount from 6 - 9% of their total Telecom charges, providing they sign up for a minimum period of time, typically 3 - 5 years. The discounts generally vary with the size of expenditure, and the period of time for which the customer is willing to sign up. The Agreement also expects the customer to make every endeavour to increase their telecommunications expenditure with Telecom by 10% per annum, and to give Telecom the status of preferred supplier. There are also "claw-back" provisions in the Agreement, whereby customers withdrawing from the Agreement during its tenor, must refund discounts received to Telecom.

For customers who are renting equipment, and who are major national and international toll uses, as well as heavy users of Telecom's data networks, the Memorandum of Agreement may be particularly attractive. Some customers have signed the Agreement for a period of ten years.

7.3 STANDARD OF SERVICE

Since the corporatisation of Telecom New Zealand, the standard of service provided to customers has steadily increased. However, this has not been without some cost increase. For example, Telecom New Zealand no longer provides 24 hour fault clearance. Both businesses and residential users must pay additionally for the clearance of faults outside normal working hours.

Clear Communications on the other hand has adopted a policy of 24 hour service. In line with their intention to provide a clear differentiation on the basis of service much emphasis has been placed on this aspect. Business customers are reporting that the level of responsiveness of Clear compared to Telecom is significantly better.

8. BARRIERS TO COMPETITION

8.1. OPPORTUNITY

New Zealand is an extremely small market by world standards. It has a population of approximately 3.3 million people, with 1/3 of that population being in the Auckland region. The South Island is the less densely populated with fewer people than the Auckland region. However, New Zealand's population is upwardly mobile, and New Zealanders are traditionally particularly eager to uptake new technology.

New Zealand is a narrow thin country and lends itself particulary well to services being supported from a central back-bone network, with a number of short spurs emanating from it. Apart from the dominant telecommunications provider, Telecom New Zealand, there are a number of other organisations which have set up their own networks, for example in the areas of television, power reticulation, and railways. However, the new network service provider, Clear Communications, has already taken advantage of these players.

The absence of regulation in New Zealand means that there are few rules by which new entrants must play. Those rules that do exist really relate to the prevention of anti-competitive practices, or certain ground rules relating to the issue of licences, for example for radio spectrum.

There are few mandatory requirements to be met before an organisation or individual can set up as a network provider. There is no statutory right given to Telecom to be the exclusive provider of services, and neither is there a limit to the number of people who can be granted "network provider" status.

One of the next areas of opportunity in New Zealand for new entrants will be competition in the cellular market. The New Zealand market is already strongly competitive at dealer and network pricing level, with 200 dealers nationwide offering a range of equipment and services. Cellular service is not yet regarded as an essential business tool. The potential customer either chooses to subscribe or do without. New Zealand is one of the cheaper networks in the world to subscribe to, but the cost of service is still a prime consideration for customers. International experience has demonstrated that where cellular network competition exists, the greatest impact is the movement of customers between networks. This is service, not cost based.

There will also be a number of niche

business is by paying full commercial rates to Telecom for access to its international services. This has forced Clear to make a decision to go their own way by buying a stake in the Tasman 2 cable, signing a contract to have a satellite dish built, and to enter into negotiations with Intelsat for overseas access. By the end of the first quarter of 1992, Clear anticipates being a fully fledged international provider.

As over 50% of the international traffic is between Australia and New Zealand, Clear will be interested in dealing directly with Australian parties such as OTC. Clear will doubtless seek a correspondent in the United States.

6.4 CELLULAR

The only licence currently awarded is to Bellsouth for the provision of cellular services using the TACS A band. The award of a second licence in the AMPS A band, is being challenged by Telecom in the High Court. At this stage it is unclear as to whom the AMPS A licence will be awarded, and there is no indication whether a third competing cellular service will be set up or not.

Bellsouth is currently undergoing negotiations for interconnect with Telecom, and have placed advertisements for staff to establishment the New Zealand operation. Commercial operation is proposed for 1993.

In the meantime, Telecom Cellular Limited is enjoying a monopoly, and is continuing to sign up new subscribers at a rate almost unprecedented in the cellular world.

There are now in excess of 60,000 cellular users in New Zealand, and market analysts suggest that there is a medium market size of between 330,000 and 500,000 mobile users in New Zealand.

7. IS COMPETITION WORKING?

7.1 USER ACCEPTANCE

In New Zealand, telecommunications has been treated as an expensive utility. For as long as users could remember, the New Zealand Post Office or lately Telecom, was the only source of telecommunications services. This resulted in telecommunications not being considered as a strategic business tool. Responsibility for telecommunications expenditure often was placed in an administrative section of a company.

Customer's, now faced with a wider range of services, are now able to exercise their powers, and ensure that telecommunication systems are chosen which not only best meet their needs, but also are able to be operated the most cost effectively. Chief Executive's are now able to make the choice on whether they manage their own operations, and they are becoming increasingly accountable to their boards in terms of cost effectiveness. This choice will grow as competition increases.

In 1970, Peter Drucker wrote that, "one of the most potentially earth shaking forces in our economy is the technology of information." (2). It has taken 20 years before the economic benefits of technology have really been able to be harnessed in New Zealand.

According to HS Dordick "...information technology and the more efficient use of information can enhance economic growth by:

- increasing labour productivity,
- increasing market reach and penetration for products and services,
- creating higher valued products and services,
- creating customised products and services for specialised markets,
- in reducing management and coordination costs" (3).

A much publicised report which has become known as "the Porter Project" in New Zealand, analyses current economic status and development options in New Zealand. This emphasises the competitive advantage brought about through the efficient use of information.

"Many New Zealand firms simply need to raise the level of their game in order to compete effectively in international markets. The need is to develop a clearer understanding of the structure of the industry, the needs of their customers, and the strategies and strengths of their competitors. This knowledge in perspective is essential to the formation of effective strategies" (4).

As with most information technology applications, user acceptance of these benefits is coming slowly. The concept of the "world telecommunications laboratory" (refer section 9) is intended to increase user awareness of the benefits of using telecommunications as a strategic weapon.

7.2 PRICING

The deregulation of the CPE market has reduced the purchase price of equipment in real terms as much as 50%. In the national tolls area business hours costs have been reduced for two principle reasons. The first is due to the progressive removal of cross-subsidies from toll use to domestic use and the second is as a result of competition. It is estimated the since deregulation, in three years a total of $350 million has been returned to business users in the form of cross-subsidy removals or price reduction due to discounting. Both Telecom and Clear are offering discounts of up to 15-20% for business users.

As part of the "kiwi share" undertakings made to the Government at the time of the Telecom sale in September 1990, Telecom undertook not to raise

Competition in the area of customer premises equipment (CPE) was one of the first areas to be deregulated in New Zealand in 1987. Deregulation offered equipment vendors the opportunity to sell their products directly to the user. All the major PABX vendors, and more recently a new wave of voice mail, call detail processor, and cable / systems installation companies have provided competition.

This area to date has probably one of the most beneficial areas of deregulation in New Zealand. Competition is fierce, with prices and service being extremely keen. There is a major shakeout occurring presently within the industry, with the belief that there are too many PABX vendors in a market the size of New Zealand.

5. USER / LOBBY GROUPS

5.1 TUANZ

The Telecommunications User Association of New Zealand (TUANZ) was formed as a nonprofit incorporated society in February 1986, in anticipation of the enormous changes through deregulation.

The aims of the organisations are to foster an understanding of the changes during regulation and how to manage them, to provide a forum for discussion of pertainent issues, and to represent users requirements and view points to government and to telecommunication suppliers. Government sees TUANZ as an important contributor to policy debates (1).

5.2 ITANZ

The Information Technology Association of New Zealand (ITANZ) was formed at about the same time as TUANZ, and has similar objectives. However, it concentrates primarily on Information Technology matters, and is more of a user group.

5.3 PRIVATE LOBBYISTS

The use of private lobbyists in New Zealand to influence telecommunications policy and decision making, is not particularly widespread.

6 WHERE ARE THE BATTLES BEING FOUGHT?

6.1 GENERAL PERCEPTIONS

Casual telecommunications observers would be lead to believe that the telecommunications battles are taking place in the area of toll bypass. In relation to the difficulties being experienced between emergent network providers and the dominant carrier, this perception can be understood. However, although the upwards spiral of toll price rises has been halted, and in real terms costs have reduced since the corporatisation of Telecom, real competition is taking place at a level which has not seen major benefits to business users.

A price war commenced in late 1991 between Clear and Telecom with the discounting of weekend toll services. Although much television and media advertising surrounded this very open example of competition, revenue volumes associated with this segment of the market are in fact insignificant. The discounting offered by both parties during the weekend, did little to bring down business costs. The actual impact on both party's revenue streams, due to the discounting was very small.

6.2 CPE

Competition in the Customers Premises equipment area has been fierce since soon after deregulation. Telecom's market share in the area of major PABX sales has been challenged by 3 major PABX vendors, Ericsson, GPT, and Philips. Telecom has reverted from renting or leasing their equipment, to offering it for direct purchase. The combined effect is that the real costs of providing PABX services to businesses has reduced. Users also have the opportunity to bring the management of many of their PABX functions in house, with attendant cost savings.

Intense competition has resulted from suppliers sharpening their pencils or improving their level of service, in an endeavour to sustain or gain market share. Technology advancement of systems have ensured that there is a ready market for new PABX systems.

In other areas, for example cable installation and data communications, a number of smaller organisations have sprung up to provide a fast and cost efficient alternative to Telecom. Through the efficiency gains due to restructuring of Telecom Corporation, and the competition brought about by the deregulation of CPE, users have seen waiting times for the installation of cabling and PABX systems reduce from in excess of one year, to weeks or months. Prices have also tumbled as a result of efficiency improvements, and intense competition.

6.3 TOLL BYPASS

Clear Communications has been the true pioneer of toll bypass in New Zealand. In entering the New Zealand telecommunications market, Clear Communications was able to take advantage of the few existing telecommunications infrastructures. Through the introduction of telephone exchanges at Auckland, Wellington and Christchurch, Clear Communications has been able to establish relatively quickly, and at a cost of some $140 million dollars, a network which has been able to challenge Telecom.

The true battle will be fought on the toll front when Clear Communications is able to achieve in excess of the 9% of national minutes required to begin negotiations for equal access to the Telecom network.

At present Clear's only access to international

Computers and others in the USA.

There is tremendous support for the concept of the WTL from organisations such as the National Library of New Zealand, the Institute of Policy Studies, and various government departments such as Treasury and Valuation. Within the Ministry of Research, Science and Technology, careful consideration has been given to the future, particularly with regard to enabling technologies, or core competencies which will be especially relevant to the maintenance and future growth of New Zealand's economy.

There are a number of new forms of products and services which can be produced and effectively exported by New Zealand. Dr. Ian Forrester of the Ministry has identified that "these new products are increasingly knowledge based or value added - like specialty food products, yacht designs, quality clothing, leisure facilities, or software programmes for computers" (12).

9.3 OPPORTUNITIES

The particular opportunities offered by the World Telecommunications Laboratory include imaging systems, applications for health, meat processing, banking, legal services, accounting, town planning, architecture, libraries, building, and tourism together with the provision of business and consumer access to information based services, the production of value added telecommunication products, and software development.

10. KEY ISSUES

The key issues which have evolved through deregulation and the emergence of competition in New Zealand can be briefly summarised as the following:

Interconnection - The ability of new entrants to gain transparent access to the existing telecommunications network in New Zealand has proved to be probably the biggest significant aspect in the introduction of competition in New Zealand.

Numbering plan - The numbering plan is a key ingredient to allow equal access of customers to any competing network.

Customer Information - If new competitors are able to have access to the 1.5 million names and addresses provided to Telecom for telecommunications services, this would allow customers to use competitive services without having to explicitly apply for them.

Cross-Subsidies - The extent of toll service subsidies to domestic services has yet to be properly ascertained. Telecom argues that competitors should help bear the cost of these subsidies, while competitors say that this is merely a device to impose extra costs on competitors.

International Access - Telecom is currently the signatory to INTELSAT. One option is to allow major New Zealand users to have direct access to INTELSAT. The calculation of international accounting rates is also under debate with countries with low collection rates claiming they are disadvantaged.

Light / Heavy Handed Regulation - The various players in the deregulated market are arguing variously for light or heavy handed regulation. Other opportunities are for an arbitration or mediation role to be played by the government, or a government appointed body. The need to revert to a relatively expensive and time consuming option of using the courts to resolve these disputes may needlessly draw out the time in which a satisfactory solution can be achieved.

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A Primer on International Accounting Rates

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2. The accounting rate established by international carriers purports to compensate for half of the international haul and the associated gateway and domestic circuits needed to originate or terminate a call. Over time, accounting rates have failed to trend downward as technological innovation accrues lower per unit costs. An imbalance in the flow of traffic magnifies artificially high accounting rates to a carrier's financial benefit or detriment depending on the volume of international traffic it generates.

This paper will explain how the settlement process works, and will identify how users and carriers have avoided accounting rate liability through creative routing arrangements despite an FCC policy that requires a uniform accounting rate for parallel routings. In view of the high stakes involved, the paper will consider what options exist for reducing United States international carrier settlement deficits without unilateral and heavy handed regulatory intervention.

3. Introduction

International telecommunications involves a voluntary "operating agreement" established between "foreign correspondents" who match half-circuits or other types of ownership units in transmission capacity. This bilateral arrangement anticipates a complete routing arrangement from caller to the intended call recipient, including the domestic "tail" circuits running to and from an international gateway facility, a satellite earth station or point where a submarine cable accesses domestic networks.

Routing arrangements and traffic volumes predictably have an impact on the terms, conditions and compensation for terminating or originating international traffic. In theory, the negotiated "accounting rate" represents the approximate cost incurred by each foreign correspondent to handle half of the international route, and all necessary domestic routing.

If the two carriers have equal traffic volumes, then they do not have to "settle accounts" and transfer funds from the toll revenues collected. However, for most telephone service routes between the United States and foreign countries [1] four factors work to generate what in 1988 amounted to a $2 billion outpayment by United States International Service Carriers ("USISCs") [2] to their foreign correspondents:

(1) United States outbound traffic volumes, greatly exceed the return, inbound flow, in part the product of rate reductions;

(2) Foreign international telecommunications rates significantly exceed what USISCs charge, thereby retarding demand;

(3) Most current accounting rates substantially exceed the actual cost of providing service, despite technological innovations that have reduced the cost of providing service; and

(4) USISCs, without apparent financial penalty, have shifted onto ratepayers the consequences of artificially high accounting rates.

A 1988 Report of the Federal Communications Commission's Common Carrier Bureau reached the conclusion that the growing accounting rate deficit partially results from the fact that USISCs charge rates to endusers substantially below what their foreign correspondents charge for the same route. [3] Given an imbalance in traffic flows, some imbalance in payments will ensue. But the Common Carrier Bureau poses the essential question "as to how much of the U.S. balance of payments deficit for telephone service is attributable to the underlying traffic flows and how much is attributable to accounting rates that are above costs." [4]

The Bureau concluded that approximately half of the deficit represents a subsidy from United States ratepayers. [5] In August, 1990, the Federal Communications Commission proposed an activist regulatory posture to encourage USISCs and their sovereign foreign counterparts to reduce accounting rates and the annual $1 billion "direct underwriting by U.S. consumers of foreign telecommunications administrations." [6]

This paper will examine the FCC's latest accounting rates initiative and its International Settlements Policy ("ISP") [7] that seeks to prevent foreign carrier tactics that exacerbate the USISC settlement deficits. The paper will explain how international carriers exploit artificially high accounting rates, while avoiding them when such rates reduce their settlement windfalls. In view of the mounting USISC accounting rate deficits, the paper will also assess the efficacy of the Commission's policy requiring adherence to a single accounting rate per route by all USISCs providing functionally equivalent service.

4. Outline of the Problem

Despite a clearly articulated preference for avoiding marketplace intervention and oversight, the FCC remains keenly interested in the accounting rate settlement process. Such sensitivity stems from the fact that in most instances, a number of USISCs must attempt to secure an operating agreement and settle accounts with a single foreign carrier.

So long as the foreign carrier has one foreign agreement, typically with AT&T, it has access to all United States destinations. Unless additional USISCs can convince the foreign carrier that additional traffic volumes will compensate for the additional costs incurred to interconnect with them, the foreign carrier has little incentive to confer additional operating agreements.

The FCC infers that foreign carriers possess both the incentive and capability to leverage their superior bargaining position by "whipsawing" one USISC against the other: "Generally this has involved a PTT seeking a modification of an accounting rate in a manner more favorable to the PTT--that is, a reduction in the rate paid by the PTT to the U.S. carrier for delivery of traffic in the U.S. or an increase in the rate paid by the U.S. carriers the PTT for delivery of traffic in that foreign country." [8]

The FCC's ISP generally requires all USISCs "offering similar service to the same foreign point [to] do so under identical accounting rates, settlement rates and divisions of tolls." [9] "Specifically, . . . [the Commission] required that operating agreements stipulate uniform accounting rates (the negotiated rate of reimbursement for service, which is shared by the initiating and terminating entities); uniform terms for the sharing of tolls (the percentage of the accounting rate to be allowed each entity--generally for direct traffic, 50-50); and uniform settlement rates (the currency conversion rate used to arrive at the currency stipulated in the operating agreement, usually gold francs (GF), U.S. dollars, or special drawing rights (SDRs))." [10]

The FCC imposed uniformity in accounting rate settlements for each route and for each service, so that no foreign carrier could seize the upper hand in revenue division negotiations and secure revenue concessions by playing one U.S. carrier against the other. [11] Without a regulatory mandate of accounting rate uniformity, the Commission theorizes that foreign carriers could in effect auction off inbound United States traffic flows to the highest bidder, i.e., the USISC willing to part with the greatest share of the toll revenues.

In application, the Commission's ISP appears to have mandated uniformity of accounting rates uniformly stuck at artificially high levels, far exceeding actual service costs. Because the ISP requires uniformity, it appears that USISCs have little incentive to press foreign correspondents for lower accounting rates. The initiating carrier would risk good corporate relations with the foreign carrier whose officers may have great leeway in determining how to route return, inbound United States traffic. The FCC's uniform accounting rate policy would mean that all other USISCs would benefit from the single carrier's initiative, probably without any adverse relational consequences.

5. Philosophy of the FCC's Policy on Accounting Rates

Routing international telecommunications traffic involves the joint venture of two or more carriers who agree to "match half-circuits" linking nations. Such participation requires collaboration in the form of consortia for joint ownership, operation and maintenance of international transmission facilities like transoceanic cables, and international cooperatives like the International Telecommunications Satellite Organization ("INTELSAT"). Typically, international facilities are collectively owned, with ownership interests allocated as a function of investment made by individual carriers.

In recognition of the coordination necessary to achieve international links, carriers enter into arrangements that establish the terms and conditions for providing service between two nations. A separate arrangement usually is negotiated for each type of service between each pair of nations. A key component to international traffic routing is the financial terms and conditions under which one carrier compensates the other carrier for agreeing to match international circuits and provide the switching and routing, including the domestic facilities, necessary to deliver calls to the intended recipient.

The accounting rate serves as the basis for dividing toll revenues between carriers jointly providing an international service. [12] It is designed to reflect the fact that both carriers incur costs in making an international service available, and that such costs should be shared equally. Accounting rates are negotiated by the participating carriers and have two components:

> 1) the unit of currency used and the applicable rate per unit of traffic, e.g. 1.34 International Monetary Fund Special Drawing Rights per minute of international message telephone service traffic is shared between USISCs and Japanese international carriers; and
>
> 2) how the accounting rate amount will be split between correspondents, usually 50/50.

Accounting rates purport to reflect the total cost generally incurred by all carriers to achieve a complete international routing, i.e., both international half-circuits and both domestic tail circuits to and from the international gateway via domestic facilities. However, FCC analysis clearly shows that "accounting rates for international telephone service ("IMTS") [13] are significantly greater than the costs of providing service." [14]

Disparity between accounting rates and actual routing costs would have little significance if the traffic volumes generated to and from the United States were roughly equivalent: there would be no major transfer of payments between carriers. Accounting rates have great significance when an imbalance of traffic streams exists as is the case for IMTS between the United States and many foreign nations. Significant tariff rate reductions in the United States has stimulated outbound IMTS calling resulting in traffic volumes far in excess of inbound U.S. flows.

Typically, the collection rates for IMTS in foreign nations, the amount endusers pay per unit of consumption, vastly exceed carrier cost and the equivalent outbound United States rate, with the result of dampening demand for inbound U.S. calling. Because USISCs generate significantly more traffic for their foreign correspondents to terminate, than the inbound, return flow, USISCs must transfer a greater amount of revenues than they receive in the settlement process.

High accounting rates mean that a net debtor nation must pay an even greater amount in net settlement payments for the disparity in traffic volumes. Despite reductions in the per unit cost of international telecommunications, accounting rates have not dropped significantly. It appears that despite increasing outpayments, USISCs have been less than vigorous in their advocacy for accounting rate reductions. While such high accounting rates do not necessarily reflect foreign carrier whipsawing of USISCs, it represents a surcharge to United States ratepayers and falsely prevents USISCs from lowering rates.

Perhaps USISC reluctance to press for lower accounting rates stems from concern that such advocacy might prompt PTT retaliation in ways that further hurt profitability. But the FCC's Common Carrier Bureau implies other reasons:

(1) international calling volumes are rapidly growing, and despite the massive outpayment in accounting rates, IMTS typically "generates at least four times as much revenue as the average domestic interstate call; " [15] and

(2) Most international telephone calls are metered and charged on a usage sensitive basis, contrary to usage insensitive private lines that are more prevalent in domestic markets.

With robust traffic growth and margins like that recently experience in IMTS, a rigorous campaign to reduce accounting rates might force rate base regulated USISCs, particularly those carriers also providing domestic services and subject to a single revenue requirement for ratemaking purposes, to institute an across the board rate reduction. Higher than necessary accounting rates in effect preserve the appearance of high operating expenses leaving USISCs with justifications for slow rate reductions, particularly in the absence of competitive necessity.

The FCC's ISP was designed to prevent U.S. international service providers from offering a better division of revenues or other concessions to curry favor with foreign carriers. Absent the ISP, the Commission infers that prospective market entrants would agree to an unequal and lower split of an accounting rate, in exchange for a foreign operating agreement. Newcomers need such agreements with foreign carriers to secure direct routes, rather than having to hand traffic off to a competitor, which already has an operating agreement, or indirectly routing traffic via an intermediary carrier with which the newcomer has secured an operating agreement, i.e., "transiting" . Presumably, incumbent USISCs also could be whipsawed into agreeing to new concessions, e.g., refraining from pushing for lower accounting rates, in exchange for foreign carrier agreements to reject newcomer requests for an operating agreement, or routing disproportionate volumes of inbound United States return traffic flows to a particular correspondent.

The only way a USISC, generating a disproportionate volume of outbound traffic can reduce its settlement payout to a foreign carrier is through receipt of offsetting inbound U.S. traffic. Because a single foreign carrier often controls all of a nation's outbound international traffic, it enjoys significant leverage when more than one USISC vies for return traffic volume. The resulting settlement deficit increases when for certain routes, USISCs actually pay out more in the accounting rate settlement than what they collect in the form of tariffed rates, e.g., when a minute of IMTS is priced at $1.00, but the accounting rate is $3.00 requiring the U.S. carrier to pay $1.50, to its foreign correspondent leaving a net deficit of $0.50 per outbound minute. Without receipt of inbound settlements at $1.50 per minute, in compensation for the U.S. half of the international circuit and the domestic termination, presumably provided at a cost well below $1.50 a minute, the USISC would continue to experience a substantial deficit in settlement revenues.

The FCC's ISP is not absolute, as the Commission has established a waiver mechanism: "[E]ach proposed modification of the terms, rates, or toll divisions of operating agreements for services which more than one carrier or service provider offers to a particular foreign jurisdiction must be submitted to the Commission . . .." [16] But USISCs have not vigorously employed the waiver mechanism, and until its 1990 Accounting Rate NPRM, the FCC has taken a reactive, rather than proactive posture to prevent foreign carrier's invitations to "negotiate or impose a more advantageous settlement arrangement." [17]

5. <u>The FCC Proposes to Get Tough on Accounting Rates</u>

In its 1990 NPRM, the FCC proposes to take a more proactive role in accounting rate oversight, going so far as tentatively concluding that it has the authority "to establish international accounting rates, to determine and prescribe just and reasonable accounting rates, and if necessary, [to] condition Section 214 grants [of authority to operate international facilities] on the implementation of lower, more cost-based accounting rates." [18] Apparently, the Commission intends to engage in dialogue foreign carriers (mostly government owned PTTs), and to use its more direct regulatory oversight on USISCs to achieve cost-based accounting rates.

The Commission proposes to link its accounting rate advocacy to primarily domestically-based objectives like universal service, prevention of uneconomic bypass, network efficiency and elimination of unjust discrimination and unlawful preferential rates. [19] With these goals in mind, the Commission makes four concrete reform proposals to:

(1) permit a USISC the option of filing a letter with the Commission (rather file a ISP waiver application subject to a procedural timetable of 21-60 days) when proposing an accounting rate reduction; [20]

(2) streamline the Commission's time for acting on ISP waiver requests to 21 days and presumably to encourage USISCs to file more waiver requests proposing lower accounting rates if they benefit United States ratepayers; [21]

(3) engage foreign governments in a more frequent and vigorous dialogue on accounting rates, in part through International Telecommunications Union ("ITU") forums and application of ITU regulations and recommendations that arguably serve as a foundation for promoting cost-based accounting rates [22] and;

(4) promote international facilities shared use and resale, that if more available, also could foster downward pressure on accounting rates by making the private line accounting rates bypass opportunity two-way, rather than the possible more frequent inbound-United States option currently available. [23]

A "get tough" policy on accounting rates, has the potential for serious foreign backlash and retaliation. While the Commission has successfully conditioned grants of regulatory authorizations on the carriers it regulates, [24] it is quite another matter to affect the behavior and the financial performance of foreign carriers. For example, when the FCC attempted to influence the timetable for construction and activation of the TAT-7 cable [25] through direct negotiations with foreign governments, its activism was considered an intrusion of national sovereignty and was deemed a violation of the Government in the Sunshine Act. [26]

Recently the FCC considered and substantially rejected imposing reporting requirements and other means for overseeing the extent of participation in the U.S. telecommunications market by foreign-owned firms. [27] While the prospect of regulation could serve as strong leverage for achieving market access parity between United States and foreign telecommunications equipment and service providers, the Commission faced nearly universal opposition on grounds that such tactics would invite foreign retaliation and would violate this nation's commitment to treat foreign and domestic enterprises alike on regulatory and trade matters.

The FCC's CC Docket No. 86-494 focused consideration on:

> whether [the Commission] can, and should, consider proposing actions that might include, among other things, limitations on access to U.S. markets for foreign-owned carriers, enhanced service providers, terminal equipment manufacturers, and core equipment manufacturers from jurisdictions that are "closed" to U.S. telecommunications service providers and equipment manufacturers. [28]

CC Docket No. 86-494 represented the FCC's attempt to compare actual marketplace conditions with a theoretical model for international telecommunications regulation. The Commission designed this model with an eye toward assessing how deficiencies in international telecommunications goods and services markets could be resolved in furtherance of competition, efficiency, equity and national security goals derived from the Communications Act. [29]

Specifically, the Commission sought to receive information, primarily through mandatory reporting requirements, so that it could better evaluate the need for its regulatory intervention to serve the objectives of "open entry, non-discrimination, technological innovation, and international comity." [30] The Commission ultimately reduced the scope of its reporting requirements on foreign enterprises operating in the United States and apparently capitulated to the prevailing view that it should not use its arsenal of regulatory oversight to threaten foreign governments, nor should it usurp the Executive Branch of the federal government on how to address trade matters.

Notwithstanding the lessons from CC Docket 86-494, the 1990 Accounting Rates NPRM once again pits the FCC against foreign governments on what can be considered a trade matter. The Commission implies that foreign carriers and their government owners/regulators actively work to sustain artificially high accounting rates. In the most egregious cases where a foreign government sanctions inbound United States resale to evade accounting rate payments and the ISP, maintains an accounting rate that ignores declining costs or supports collection rates well in excess of what United States callers pay, the Commission proposes to "establish . . . determine and prescribe just and reasonable accounting rates." [31]

Such threats of unilateral action appear directed at foreign governments and their PTTs singularly, rather than primarily at the USISCs, who appear to have willingly capitulated to artificially high accounting rates. It seems that the Commission pays more attention on how its can affect and regulate the actions of foreign governments and carriers, rather penalize USISCs, with readily available regulatory sanctions, for their failure to negotiate accounting rate reductions.

Perhaps the Commission's initiative on international shared use and resale [32] indicates that a unilateral announcement only initiates the process for extensive bilateral and multilateral dialogue. The Commission's proceeding has languished in part because USISC tariffs no longer prohibit outbound resale, and an FCC statement supporting resale cannot supersede ITU deliberations or prevent other countries from maintaining restrictions that the Commission acknowledges will "preserve the present above-cost international accounting rate structure."[33]

The Accounting Rate NPRM may prompt renewed charges that the Commission too readily resorts to unilateral policy initiatives without appreciation of the need for international comity. Rather than risk exceeding the scope of what it can do without a government trade portfolio, the Commission should consider what it can do at home with the carriers it licenses. On this front, the Commission does mention that it might condition its Section 214 grants of service authority, but such power applies only to future applications.

The Commission could more effectively prod USISC activism to reduce accounting rates by prescribing cost-based rates for ratemaking purposes and treating as revenue some portion of the $1 billion overpayments made by United States ratepayers. Rather than constitute a confiscation of carrier revenues, such a restatement of carriers' finances would for the first time saddle the USISCs with responsibility and a direct financial burden for failing to bring accounting rates down to cost.

6. Conclusion

The FCC established the ISP to prevent PTT whipsawing, i.e., the ability of PTTs "to play two U.S. entities against each other, to manipulate traffic flows, and to retain a greater percentage of the accounting rate at the expense of a U.S. carrier." [34] If anything, lower termination costs to the PTT might stimulate outbound traffic and encourage the PTT to reduce its collection rates. More importantly, particularly if the FCC would impose some financial penalty on the USISCs for artificially high accounting rates, use of private lines or other bypass methods for inbound United States traffic should prompt USISCs to get serious on negotiating lower accounting rates in proper bilateral forums.

Lower collection rates, improved services, increased competition and the lack of market power possessed by a carrier--the very factors the Commission uses to consider requests for waiver of the ISP--are the likely positive outcomes if the Commission imposes financial risks on USISCs for failing to negotiate lower accounting rates and for failing to have reduced collection rates that could have been supported by lower accounting rates.

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The reticence of USISCs to apply for waivers underscores the comfortable and profitable world in which they operate, despite a substantial net outflow of hard currency. PTT actions that disrupt the return flow of high accounting rate traffic, and not the ISP, may constitute the kind of pressure that forces accounting rates closer to cost.

Under the present ISP regime, USISCs are content to forego billions of dollars that could have reduced rates even further for United States ratepayers. Rather than target foreign governments for a risky jawboning initiative, the FCC could better create further downward pressure on rates, by forcing the USISCs to abandon the comfortable status quo and consider high accounting rates as lost corporate revenues.

In 1991, the Commission issued its Report and Order in CC Docket No. 90-337. [35] The Commission eased away from direct confrontation with foreign PTTs over their sovereign right to negotiate accounting rates, opting to concentrate on domestic "procedural reforms that remove any U.S. regulatory impediments to lower, more economically efficient, cost-based accounting rates . . .. [36] The Commission formalized its proposals to ease administrative burdens to the implementation of lower accounting rates and deviations from uniformity by United States international carriers. But it stepped back from unilaterally ordering changes in the process under which accounting rates are negotiated, or imposing any financial burden on carriers, domestic or foreign, that have profited from above cost accounting rates. The Commission instead relies on its expectation that individual carriers will perceive new incentives to negotiate lower rates, and for forums organized by the International Telecommunication Union to encourage cost-based rates.

The Commission's Report and Order refrains from getting tough, opting instead to allow the carriers more time to remedy the process, despite the expression of "concern[] that the present level of certain intra-regional accounting rates or other country-to-country arrangements suggest that U.S. carriers may not only be required to pay above-cost accounting rates, but that U.S. carriers are subject to discriminatory treatment in this respect." [37] Instead, the Commission created a Further Notice of Proposed Rulemaking in CC Docket No, 90-337 [38] as the vehicle to "continue our regulatory oversight," [39] and presumably also to serve as a veiled threat "to take further regulatory action" should U.S. carriers fail to negotiate lower accounting rates. [40]

The Further Notice directs the Common Carrier Bureau to conduct another study of international calling prices and to suggest remedies for the kind of overcharges it has already identified. The Further Notice also proposes to require U.S. carriers to report their progress in negotiating accounting rate adjustments, places greater emphasis on resale and shared use as a vehicle to prod downward accounting rates, and explores whether a better analytical framework might exist for assessing insufficient progress with particular nations.

The Commission again refrains from placing a cap on the amount it will deem a legitimate accounting rate payment, or placing the U.S. carriers under its jurisdiction on notice that the Commission will order refunds for overpayments. [41] The most drastic leverage it now appears willing to consider is conditional Section 214 authorizations to require US licensees to ensure nondiscriminatory treatment of all make telecommunications facilities, services and equipment markets competitive and supportive of previously articulated government objectives.

1. The United States has no significant balance of payment deficit for "record" services, e.g., telegram and telex traffic. "Traffic flows and financial settlements in the telegram and telex market largely offset each other." "INTERNATIONAL ACCOUNTING RATES AND THE BALANCE OF PAYMENTS DEFICIT IN TELECOMMUNICATIONS SERVICES, Report of the Common Carrier Bureau to the Federal Communications Commission, 6 (Dec. 12, 1988). [hereinafter cited as Common Carrier Bureau Report].

2. Regulation of International Accounting Rates, CC Docket No. 90-337, Notice of Proposed Rulemaking, 5 FCC Rcd. 4948 (1990) [hereinafter cited as Accounting Rate NPRM].

3. "[I]t is clear that the price of calling the United States has not declined as rapidly as the price of calling from the United States. Because American prices were lower to begin with, the differential in prices has increased. This has undoubtedly contributed to the continued and increasing imbalance in traffic flows and in turn contributed to the rapidly growing balance of payments deficit." Common Carrier Bureau Report at 29.

4. Id. at 42.

5. Id.

6. Accounting Rates NPRM, 5 FCC Rcd. at 4948.

7. Implementation and Scope of the International Settlements Policy for Parallel International Communications Routes, CC Docket No. 85-204, Notice of Proposed Rulemaking, FCC 85-332 (rel. July 3, 1985) [hereinafter cited as International Settlements Policy NPRM], Report and Order, FCC 86-30, 51 Fed. Reg. 4736 (Feb. 7, 1986), [hereinafter cited as International Settlements Policy Report and Order] on reconsideration FCC 87-61, 2 FCC Rcd. 1118 (1987), 62 Rad. Reg. 2d (P&F) 408 (1987) [hereinafter cited as International Settlements Policy Reconsideration] on further reconsideration, FCC 88-93, 3 FCC Rcd. 1614 (1988), 64 Rad. Reg. 2d (P&F) 956 (1988) [hereinafter cited as International Settlements Policy Further Reconsideration].

8. International Settlements Policy Reconsideration, 62 Rad. Reg. 2d (P&F) at 410.

9. Id. at 410-411.

10. Id.

11. The FCC's Common Carrier reported in 1988 that about 75 cents of every dollar collected by USISCs for international telephone calls is owed to the foreign carrier to terminate the calls. This results in 70% of all revenues collected from United States customers being paid out to foreign entities. Common Carrier Bureau Report at 8.

12. For an extensive analysis of Accounting Rates and the division of toll revenues, see Aulik, Financial Structures in Competitive Telecommunications: An International Overview (Program On Information Resources Policy, Harvard University, Cambridge, Mass. 1987).

13. Unless expressly exempted all types of international telecommunications services are covered by the ISP. The Commission has reaffirmed that the ISP applies to voice services and indirect routing arrangements. See International Settlement Policy Reconsideration, 62 Rad. Reg. (P&F) at 420-421. However, as to enhanced services, the Commission reversed itself and decided on Further Reconsideration to exempt such services from application of the policy. International Settlement Policy Further Reconsideration, 64 Rad. Reg. (P&F) at 959.

14. K. Stanley, The Balance of Payment Deficit in International Telecommunications Services, at 19, Industrial Analysis Div., Common Carrier Bureau, Federal Communications Commission (Dec. 12, 1988).

15. Common Carrier Bureau Report at 9.

16. MCI Telecommunications, Inc. Revisions to Tariff F.C.C. No 1 Accounting Rate for Call USA International Long Distance Service, Transmittal No, 543, DA 89-1040 at 6 (rel. Aug. 28, 1989).

17. International Settlements Policy NPRM at 17.

18. Accounting Rates NPRM at 20, para. 20.

19. Id. at 8, para. 7.

20. Id. at 11-14, paras. 11-13.

21. Id. at 14-16, paras. 14-15.

22. Id. at 16-17, para. 16.

23. Id. at 17-21, paras. 17-20.

24. The Commission notes that it conditioned granting authority for USISCs to participate in construction and operation of the TAT-5 international submarine cable on the USISCs' agreement to file a 25% IMTS rate reduction. Id. at 21, n.61.

25. See Policy to Be Followed in Future Licensing of Facilities for Overseas Communications, 67 FCC 2d 358 (1977) (rejecting applications to construct and operate TAT-7), partial recon. granted, 7- FCC 2d 1348 (1978), modified, 71 FCC 2d 71 (1979), on recon. 71 FCC 2d 1178 (1979) (TAT-7 approved).

26. ITT World Communications, Inc. 77 FCC 2d 877 (1980) (order denying denying petition for rulemaking on permissible scope of FCC contacts with foreign administrations) ITT World World Communications v. FCC, 699 F.2d 1219 (D.C. Cir. 1983), rev'd on other grounds, 104 S.Ct. 1936 (1984).

27. Regulatory Policies and International Telecommunications, CC Docket No. 86-494, Notice of Inquiry, 2 FCC Rcd. 1022 (1987), Report and Order and Supplemental Notice of Inquiry, FCC 88-71 (rel. March 25, 1988), Order on Reconsideration, 4 FCC Rcd. 323 (1989).

28. Regulatory Policies and International Telecommunications, 2 FCC Rcd. at 1022.

29. 47 U.S.C. Sec. 151 et seq. (1989).

30. Id. at 1024.

31. Accounting Rate NPRM at 20, para. 20.

32. Regulatory Policies Concerning Resale and Shared Use of Common Carrier International Communications Services, Notice of Proposed Rulemaking, CC Docket 80-176, 77 FCC 2d 831 (1980).

33. Accounting Rates NPRM at 18, para. 17.

34. International Settlements Policy Report at 7.

35. Regulation of International Accounting Rates, CC Docket No. 90-337, Phase I, 6 FCC Rcd. 3552(rel. May 23, 1991). [hereinafter cited as Accounting Rate Report and Order].

36. Id.

37. Id. at 3555-3556.

38. Regulation of International Accounting Rates, CC Docket No. 90-337, Phase II, Further Notice of Proposed Rulemaking, 6 FCC Rcd. 3434 (1991) [hereinafter cited as Accounting Rate Further NPRM].

39. Id.

40. Id. at 3435.

41. Id. at 3436.

SOME EXPERIENCE ON NETWORKING IN CNR

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1. ABSTRACT

CNR is the acronym of the Italian National Research Council, one of the public institutions supporting non-profit research in Italy.
This paper will focus on the network used at CNR and its relationship with other national and international networks.
It briefly describes the experience gained during the development and management of the CNR's network and also the solutions adopted to integrate into one backbone network the four protocols TCP/IP, DECNET, SNA, and X.25.

2. INTRODUCTION

CNR is the acronym of the Italian National Research Council; one of the public institutions within which non-profit research projects are financed.
CNR is composed of many Institutes distributed in many Italian cities.
One of these Institutes is the CNUCE that is the primary Computer and Network Centre for the CNR and one of the primary network centres within Italian Networks.
This paper gives an overview of CNR Networks and of its relationship with other National and International Networks.
The CNR Network has at least two groups of users:
Academic users and Administrative users.
The first group uses all typical network services.
Researchers depend on electronic mail for communicating with each other in the world, some make intensive use of file transfer between hosts and the remote login facility.
The network is very important also for the Administrative users.
Since the CNR has its Central Administration Department in Roma, the exchange of administrative information between the Central Department and every CNR Institute in the country is very important.
To achieve this purpose CNR started a project (named "Institutes Network"). We must consider that the research activity of many of the Institutes in CNR do not have a close relation with Computer Science.
Today every CNR Institute has at least one MS-DOS Personal Computer connected via local area network (if possible) or via a switched asynchronous line to the nearest CNR Network Computer Centre.

3. THE NETWORK

The network topology includes 12 primary sites situated in as many cities. Each one offers network access to adjacent nodes.
Those Computer Centres were designed according to local needs; when CNR began to use computer networks, most communications were among machines running the same operating system. For example, in the beginning, most of the traffic was between VAXes running VMS over leased data transmission lines; DECnet is the natural protocol for such traffic.
Early applications were electronic messaging and terminal emulation.
There was a backbone for each protocol (DECnet, SNA, TCP/IP, X.25). Often between two Computer Centres there was more than one leased data transmission line (one for each protocol used); in addition the CNR network is integrated with networks belonging to other public institutions in Italy to form a heterogeneous (for protocols and institutions) National Network.

4. THE NETWORK EVOLUTION

In March 1988, the Minister of University and Scientific and Technological Research founded the GARR (Group for the Harmonization of Networks for Research).

From the work of this group derives the actual Italian network topology.
The present primary sites of the network are located in Milano (CILEA), Bologna (CINECA), Bologna (INFN/ENEA), Pisa (CNUCE-CNR), Roma (INFN/NIC), Frascati (ENEA/INFN) and Bari (TECNOPOLIS-CSATA).
The architecture of the backbone is made up 2 Mbs data transmission lines and multiplexors (TDM).
This structure is used for four different communication architectures (SNA, DECNET, TCP/IP and X.25) awaiting migration to ISO/OSI standards; in particular the X.25 subnetwork will be the experimental base for the ISO/OSI standards.
Since the GARR backbone was created, the CNR Network information groups have started to consider a new CNR network topology, with relationship to the new GARR backbone.
The CNR networking groups decided to work on the problem of the coexistence of heterogeneous families of protocols on a unique backbone.
Important decisions had to be made regarding the backbone architecture. Three possible solutions were considered:
a) a backbone made up of TDM's (such as GARR backbone).
b) a backbone based on a X.25 network.
c) a backbone based on a TCP/IP network.

5. INTERNETWORKING

By now, most small and big laboratories have computers connected using Local Area Networks (LAN) to exchange data.
We understood that our solution had to interconnect not single hosts but Local Area Networks all over the country.
The concept of networks of networks has emerged.
Our objective was to permit the coexistence of heterogeneous families of protocols in harmony with each other within an overall regional, national and international network plan that maximized access to network and its resources; namely we wanted give to the user, remote login, file transfer, and electronic mail services between heterogeneous network architectures.
We also wanted to consider the new OSI protocols to foresee the migration to this new network architecture.

From this point of view the solution using a backbone made up of TDM's was discarded.
Even though this solution permits the coexistence of heterogeneous data link protocols on the same leased data transmission line (namely we can say that we have realized an integration at physical layer), it has some disadvantages; for example:
- The network topology is not as flexible as we adopt a solution integrating the heterogeneous network architecture at a higher layer than the physical layer.
- This solution doesn't realize a good integration of the four primary network protocols used in CNR.
To realize this we had to select a protocol to provide a basic carrier service for CNR. This protocol is the one on which the backbone was implemented.

6. X.25 AND TCP/IP

Two protocols were considered X.25 and TCP/IP.
X.25 was considered since it conforms to the OSI specifications and permits the use of PSDN for our backbone. Some analysis of the PTT tariffs charged by ITAPAC (a volume charged network) showed that using the Italian PSDN as the primary backbone was not an attractive solution for CNR, besides X.25 is not as widely implemented as TCP/IP.
A question was: Can we adopt TCP/IP as the basic protocol for our backbone and also maintain the X.25 protocol as an experimental one?
Adopting a protocol to provide a basic carrier service shouldn't mean that only the one protocol will be permitted on CNR network. Machines running proprietary protocols should continue to communicate with each other using that one.
The solution was found in a Multiprotocol router.
The router chosen was CISCO for its technical merit and because it is widely used.
This means that the basic protocol chosen for CNR network is TCP/IP.
The CISCO is an IP router, a DECNET router, an OSI router, and an X.25 switch and, in the near future it will be able to carry SDLC frames between serial connections with SNA hosts.
The CISCO can also work as bridge and remote bridge.

Most of this functionality realizes what we named Network Layer Internetworking; but CISCO has another important feature, it can act as a router between OSI CLNS/CONS to permit a Transport Layer Internetworking. This feature will become more important in the near future as OSI becomes accepted.

7. MANAGEMENT

The network is managed by a Technical Working Group. This working group consist of representatives from the computer services staff in each Institution and it is responsible for the technical development, applications, availability and operational aspects of the network.

8. SERVICES

EARN, HEPNET, INTERNET, EUnet are the primary international Research Networks to which the CNR's backbone is connected; besides there are also access points to the National PSDN (ITAPAC) and to the IXI (International X.25 Infrastructure) that provides a basic X.25 carrier service operating at 64 Kbit/s between all the major Western European countries.
All the services offered by these networks are accessible to the CNR researchers.
From all these services emerges the Electronic-mail service. The most important and popular network service in the world.
For this service we achieve a high level of integration over such heterogeneous networks, by adopting the RFC822 addressing scheme.
It, therefore, appears to the electronic mail user that there is only one network. The users do not have to worry about where the network site they want contact is; the network can work that out and route accordingly.

GLOBAL TELECOMMUNICATIONS STANDARDS. WHO NEEDS THEM?

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ABSTRACT

The spread of global telecommunications throughout the world is having a profound impact on international trade and politics. International events are unfolding in many communications forms as they occur. The limitation of this information to television and radio broadcasting is no longer true. Electronic mail systems, facsimile, satellite news gathering directly to the home and data services are playing major roles in the global observance of international events. If global standards were in place, even more sophisticated systems such as B-ISDN and HDTV would also be available to the public; but can we wait for internationally agreed solutions to the development of these standards or is the competitive development of new "de facto" standards the answer to the spread of new telecommunications technology?

This paper explores both sides of the issue in the light of radical restructuring proposals in the international telecommunications standards setting bodies such as the ITU and ISO.

Background

Well established international organizations provided an adequate forum for the development of telecommunications standards for the global growth of telegraphy and telephony. During that period, the emphasis was on better ways to operate these services and improvements to the transport systems to provide greater carrying capacity and, to a lesser extent, better quality. Though not simple, these services lacked the complexity of the new telecommunications services that have emerged in the 1980's and early '90s. In addition, the enhanced capabilities of modern transport systems resulting from the enormous advances in technology, are promoting the implementation of more new service types almost daily. The international standards bodies, such as the International Telecommunications Union (ITU) and the International Standards Organization (ISO), are rushing to reorganize their standards development process to keep pace with the demands for new global telecommunications standards and new "regional standards organizations" (RSOs) have been formed in an effort to at least ensure that telecommunications standards do not lag far behind the technology in regions of the world under their jurisdiction; regions where national regulation has been reduced and competition increased.

Many questions are being asked about (a) the ability of the international organizations to restructure in time to meet the new demands for standards development and (b) the true role of the RSOs (collaborators or competitors). Many questions are being asked about the possibility of the national governments "reinjecting" themselves into the standards development process in those countries that have recently liberalized their telecommunications policies, to "supervise" the standards processes more efficiently; and questions are being asked by those countries that have not yet followed a path of telecommunications deregulation about the merits of this process.

These events beg the question, do we really need a global standards setting process or can we rely on "de facto" standards set by the industry leaders?

The case for De Facto Standards

The ITU is the international organization responsible for the regulation and planning of telecommunications worldwide; for the establishment of equipment and system operating standards; for the coordination and dissemination of information required for the planning and operation of telecommunications services; and for the promotion of, and contribution to, the development of telecommunications and related infrastructures. It is a treaty organization and an agency of the United Nations. Over the years, it has done a sterling job of coordinating the development of

"recommendations" for radio and satellite systems in its committee CCIR and for telephony and telegraphy systems in its committee CCITT. With the advent of such new technology driven networks such as ISDN, it found that the pace of the introduction of new services, systems and networks was such that a complete reorganization of its modus operandi was essential to meet the needs of the changing global industry. This realization, (the CCITT first saw this in at its Plenary Assembly in 1984 and confirmed it in 1988; the ITU at the Plenipotentiary in 1989; and as a consequence, the CCIR at its Plenary Assembly in 1990), is to be applauded and if the ideas for the reorganization were put in place within a few months of the identification of the need - as in a large corporation - by this time we could expect that the ITU would be postured to tackle the new world order. Unfortunately this is not the case.

The ITU process by its very nature, demands that the restructuring concepts required the attention of several review committees le d by a "High Level Committee" studying the ITU as a whole and subservient committees studying the CCITT and the CCIR. The results of these studies will be reviewed by the member countries of the ITU at a special Plenipotentiary in September 1992 and if approved, the transition plan will extend until 1996 before the "new" management and operating arrangements are in place.

The bottom line here is that twelve years will have elapsed since the first warning signs of structural instability in the ITU process were first detected by the CCITT until the implementation of corrective reorganization. Twelve years in which the composition and operation of the global telecommunications business has changed dramatically in the first seven years; and who can predict the changes we will see in the next five. This, despite the fact that some of the best brains in the industry lead and participated in the various committees -- and the committees worked long and hard to reach consensus. As a hard working committee member said in response to a request for more speed, "You can go only so fast down a one lane road".

Maybe the ideal solution to the development of standards for the telecommunications business is through an international organization. But the fact of the matter is that the present process results in too little too late. The user community is much more educated regarding the telecommunications services they require and cannot tolerate delays in the application of new technologies vendors demonstrate due to a lack of standardization. The formation of the RSOs indicates clearly that global solutions are not timely and even these organizations are finding it difficult to keep up with the user demands and the technology on a "limited" part of the global networks.

Large manufacturers and telecommunications systems providers are offering attractive new services based on proprietary technology that are being gradually accepted as the norm. Waiting for these services to be embraced on a global basis through the existing international standards process slows growth and reduces efficiency of commerce.

The Case for Internationally developed Standards

Telecommunications history is dotted with expensive examples of parochial policies in standards setting. Developing countries are the biggest sufferers of the availability of "nearly the same" technology; but the highly developed countries are not immune to the problem and are especially vulnerable to incompatibility of fast developing and complex new software driven services so attractive to the sophisticated user. We are all aware of the problems (and waste of resources) associated with the interworking of T and E digital systems and NTSC, PAL and SEACAM video systems. Some of us are aware of the high cost to the industry of less obvious global telecommunications incompatibilities such as telephone tones and numbering plans; data system protocols and formating; electronic mail application programming interfaces; and basic system automatic testing procedures; not to mention the reduced efficiency and resulting usefulness of the lack of globally agreed standards for the comparatively new technologies of ISDN (supplementary services) and digital circuit multiplication equipment.

Today multinational manufacturing organizations are offering proprietary telecommunications equipment and systems to many countries around the world. No longer can one assume that country "y" will have brand "x" switching equipment. Country "y" may have more than one telecommunications system and several different types of switching equipment. Doing telecommunications business with country "y" would be a nightmare without some form of global standardization process.

A so-called "de facto" standards process has been tried and discarded in a number of countries and global regions. Marketplace competition is a way of life in many countries and is totally incompatible with the concept of allowing the correct standards to emerge by majority usage. Telecommunications is the nerve center of many international businesses and if a chaotic situation prevails in this industry, for even short periods, the impact on commerce in general is unacceptable.

The criticism that global standardization takes too long has some validity. The solution is not to discard the process but to improve it. This is precisely what the ITU High Level Committee is doing and similar actions are being undertaken in the ISO.

Summary

It is hard to argue against the need for the development of telecommunications standards on a global basis - particularly in the Pacific Ocean Region. Many companies in this region depend on rapid communications to reach and compete aggressively in global markets. Similarly, the rest of the world's trade centers need access to Pacific region centers of commerce to enhance their competitiveness. Rapid multi-destination cross border communications can only be established with multinational technical and operational agreements, i.e., telecommunications standards; but we can't afford the present delays in achieving these agreements.

Although the international standards setting organizations are undertaking a restructuring program, perhaps they are not going far enough. To meet the present needs of the telecommunications providers and users alike, some of the traditional and until now, sacrosanct, policies may have to be challenged. For example:

1. Let's agree to develop international standards in one language only. This conference, which is annually a great success, is an example of the virtue of this process.

2. It is vital to get "global" inputs in the standards development process; both developed and developing countries views are required. However, the realities of the economies must be taken into account and the prohibitive cost (financial and human resources) of travel to a central European location to express opinions, recognized.

Why can't we take the standards development process "on the road"? Meetings can be arranged in accessible places with the cost offset by the savings in translation and interpretation services as in number one above. Nomadic meetings have been very successful in the North American Committee T1 forum and to some extent, in INTELSAT.

3. As with communications, global standards development should not be restricted by any one set of local customs. Arrangements should be made to permit the process to take place throughout the year.

The Working Group set up at this conference to explore this subject will no doubt find other possible changes to increase the efficiency of global standards development. But whatever the findings, time is of the essence.

Emergency Services Telecommunications - A Specialized Telecommunications Need

Submitted By: Gerald J. Pierce
Summa Four, Inc.

1. ABSTRACT

Emergency Services Telecommunications represent an important, but specialized area of need. Wider opportunities are needed to discuss solutions developed for special areas. The PTC can offer a forum for such discussion.

2. CONCEPT: Typically, emergency services telecommunications are handled as a sort of hybrid entity which is somewhat external to the normal operations of a telecommunications operating organization.

The following broad definition is suggested for emergency service telecommunications;

"The use of existing and available technology to provide communications users, both governmental agencies and citizens, with the means to communicate the existence of emergency situations, and to coordinate response to these situations."

This paper is intended to present a conceptual model encompassing the range of possible emergency services telecommunications needs as they relate to the wide variety of areas represented by the membership of the Pacific Telecommunications Council (PTC).

A further intent of this paper is to stimulate an exchange of ideas among PTC members which will increase an understanding and awareness of the various solutions available to their organizations.

The approach taken is to present the model in graphic form, and then to discuss the range of solutions, citing both theoretical and real-world examples. The approach will address two areas of need suggested by the definition above, first; the need to communicate the existence of emergency situations, and second; the need to coordinate the response to these situations.

In many, but not all cases, the reporting of an emergency situation is done by a telecommunications end-user, typically a citizen. It will be seen that the nature and quality of such reporting is related to the general availability of telecommunications resources.

The coordination of the response to an emergency is virtually always a group activity, and more often than not, a governmental response. In many places, the questions of responsibility for, and jurisdiction over, the response can become considerably more complex than the actual response.

3. MODEL: The graphic model (Figure 1) is intended to represent the interrelationships of population size, population density and level of technology. Simply stated, the model traces the population density on an ascending scale vertically, and the population size on the horizontal axis.

This approach allows the creation of an hypothesis concerning the level of telecommunications complexity required for each of the two need areas - reporting and coordination. Briefly stated, the hypothesis is:

"The level of telecommunications complexity required reflects the population density and size in the area where the emergency occurs, as well as the overall level of technological sophistication available."

This may, at first glance, seem somewhat simplistic, because it could easily be restated as: "People use the tools available to them in an emergency." The purpose of the hypothesis is however, to stimulate discussion, and the key points to be addressed in the discussion are telecommunications complexity and deployment of technologically sophisticated systems.

The cases are selected to exemplify characteristics of the model, and are by no means all-inclusive. PTC members will readily identify areas within their own areas with similar characteristics. One area for future PTC meetings would certainly be to discuss solutions provided for a wide range of emergency services situations.

CONCEPTUAL MODEL

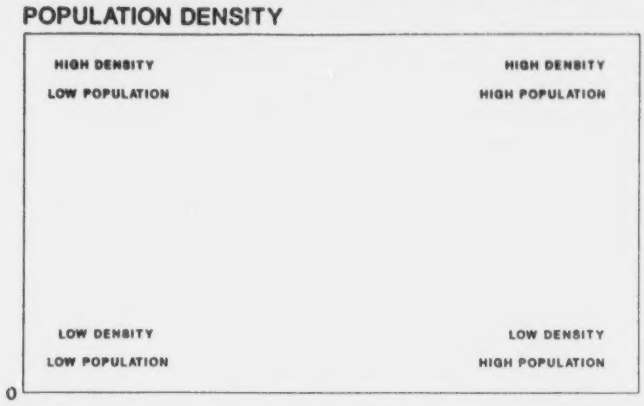

FIGURE 1

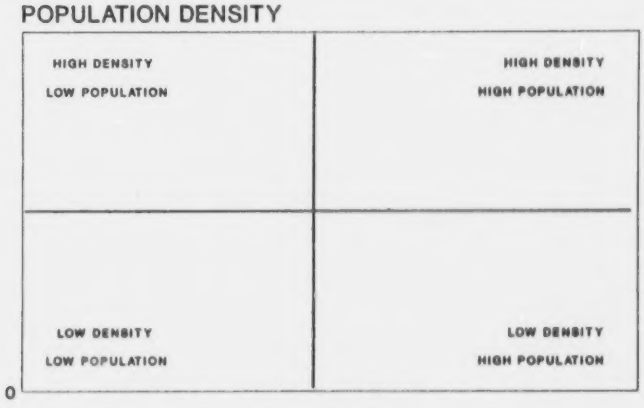

FIGURE 2

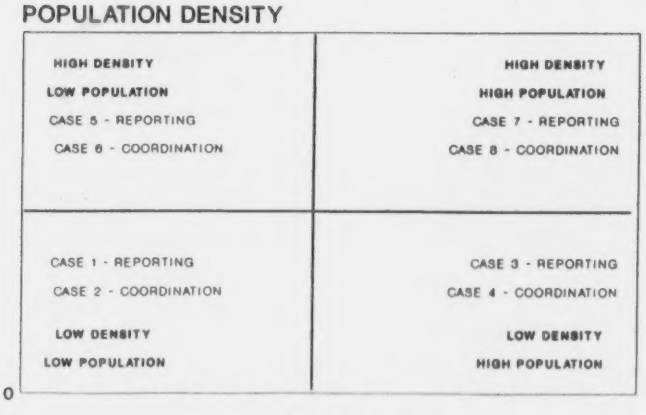

FIGURE 3

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Clearly, to research all of the possible ranges throughout the area covered by the PTC membership would be difficult, if not impossible. Therefore, the cases represent a mix of actual and theoretical, and are individually identified as such. The writer has visited many of the Pacific Rim countries, and has endeavored to portray representative examples. Again, future PTC sessions will certainly afford opportunities for writers to provide actual, rather than theoretical cases. This potential will allow for sharing of related experiences.

The model may be subdivided into four quadrants (Figure 2). The lower left corner represents an area with low population size and low population density. Such areas typically have fairly simple telecommunications technology, and limited resources.

Self-help is the norm for most emergency situations. Note, however, that such locations may have the greatest potential for high-tech solutions which are both affordable and easy to maintain.

The lower right hand corner, by contrast, has high population density with small population size. Since the population is more concentrated, it is reasonable to assume that a higher level of technology will be deployed. The population will have access to some kind of emergency services, and have the means to report an emergency when it occurs. Increasing the level of technology deployed will encounter the barriers of cost and replacement of existing systems.

In the upper left hand corner, we have a large population size with low density. A representative case would probably involve a larger geographic area, so distance is a factor. Individual, isolated nodes will still rely on self-help, but the overall size of the population allows for the possibility of more sophisticated technology to coordinate responses from centralized operations.

The area in the upper right hand corner, of high population size and high density, is most easily identified as an area where high degrees of technological sophistication can be supported. It is both more efficient and more effective to use this level of sophistication and deployed systems will be more likely to be state-of-the-art.

4. CASES: A total of eight cases are presented, one for each quadrant for reporting, and one for control. Plot points are located to identify the cases.(Figure 3)

4.1 Low size/low density

This population area represents remote nodes of population, with limited resources because of size, and a need to call for help from outside when an emergency beyond their scope confronts the population. Areas of jungle, mountainous terrain, islands or desert might be classified in this category. In the Pacific rim area, areas in Irian Jaya, Papua New Guinea, Alaska, and the Phillippines for example, might be typical.

4.1.1. Case 1. Emergency reporting.

Emergency reporting in this area reflects the fact that isolation is characteristic and self-help is the norm. Thus, initial reporting is local, and will use whatever means is feasible. For situations of greater complexity, external expertise is required, and will be summoned if the situation requires it.

Communications in this environment may be used to summon self-help, as in calling a neighbor or summoning members of a volunteer fire department composed of community residents. Immediate medical assistance is often first aid, but communications are utilized to get directions on how to handle cases,again drawing on external expertise.

Identifying the actual location of the emergency is often a problem. Because of isolation and distance, the reporting person may not be able to specify the location. A means of identifying locations with precision is needed, most especially when situations requiring external aid arise (i.e. aeromedical evacuation).

Technology used may be open, copper wire circuits, or copper cable. When terrain does not permit the use of such technology, as is often the case in such areas, entrance link radio or microwave has been utilized, as well as satellite transmission.

4.1.2. Case 2. Emergency Coordination

As noted above, self-help is the norm. Initial coordination is by means of existing associations within the community or by ad hoc arrangements depending on the nature of the emergency.

Coordination is accomplished by means of local communications which may or may not be telecommunications. In truly isolated areas, runners or visual/audible signals may be used.

When specific types of emergency (cyclonic storms, volcanic eruptions, floods, forest fires) occur on a periodic basis, the community may evolve its own informal structure to respond to the problem.

Formal communications will again depend on the type of technology deployed. Most areas with the population characteristics specified are highly unlikely to have any wire-based communications. Radio is most typical, and that very probably is available only through some government agency.

Note, however, that as technology advances, technical solutions are becoming available to suit the needs of areas like this. Enhancements to the communications capabilities can take advantage of some highly advanced solutions.

One particularly appealing solution is the use of satellite earth stations. The latest advances allow an earth station to be small, rugged and with lower maintenance requirements. In an area of this type, such a method may be affordable.

In case of major disasters, Pekka Tarjanne of the International Telecommunications Union (ITU) has proposed the use of transportable earth stations for emergency communications. An ITU project has been proposed to facilitate the speedy movement and customs clearance of such equipment. (2)

4.2 Low size/high density.

This type of area is somewhat unique.It is typical of areas that are geographically remote, but well-established, with economic or physical conditions which allow, or perhaps even demand living in a concentrated area.

Populations living in remote mountain valley areas would exemplify this type of area. Pacific islands and other areas where the population is of high density because of the ability to easily maintain themselves with crops or hunting/fishing would also be representative.

4.2.1 Case 3. Emergency reporting.

Because of population density, more formal support means may exist, but they will quickly be overwhelmed by the demands of a large scale emergency situation. Nonetheless, the efforts using existing resources can be critical in saving lives, while other more distant, emergency response units are mobilized and sent to the scene.

Radio equipment is widely used for this type of application. However, the operating system may be required to have the ability to resist high degrees of heat and cold,as well as ambient humidity. Sealed cases for equipment are typical for such applications.

The maintenance of radio equipment can be difficult, but a variety of solutions have been developed. Modular assembly replacement, using spares maintained on site is desirable, but the feasibility of this approach in areas with climatic extremes must be analyzed carefully.

Note that such spares must also be protected environmentally just as the operational system has been. Self powering of systems is becoming more feasible with the advent of solar panels, and they are widely utilized.

4.2.2 Case 4. Emergency Coordination

Coordination of emergency response is done with local communications means first. As with the case above, radio is the typical means of coordination of help from outside the area, and, if available, from within the area.

Another means suggested by the ITU is the use of cellular telephone technology to be used by emergency responders.(3)
In the Southeastern U.S., recent hurricanes have caused significant damage when striking land and passing over populated areas. Normal communications have been made difficult or impossible because of severed or damaged cable or wire and fallen telephone poles. In recent cases, cellular telephones were issued to emergency workers and utility repair crews, and proved an effective communications means.

4.3 High size/low density

These are areas of great geographic extent, typically with small, dispersed population nodes. The total population is great in size, but so widely dispersed that it cannot effectively be mobilized to respond to emergencies. The challenge of distance is a major limiting factor in emergency response.

A representative area in the Pacific Rim would be the Australian outback, where large distance are common, and the population is in small towns and remote cattle or sheep stations.

4.3.1 Case 5. Emergency reporting.

Radio is the most commonly used means for emergency reporting. This area is ordinarily one with a centrally located single source of expertise, such as a provincial or territorial government.

This area will depend on self-help for most ordinary emergencies. When situations demand external assistance, it will likely be requested by radio. Distance is overcome by this means, and the delivery of aid may be in the form of instructions as, for example,how to handle a medical emergency.

Initial reports will be made by the means available, and again, non-physical means like radio or satellite link are most feasible. The cost versus return of constructing a cable link over long distances is prohibitive, unless it is somehow subsidized by government. Comparatively, a radio transmitter for common use, centrally located, can be quite cost competitive.

Both the radio and satellite solutions have been used in Alaska, where distance and isolation are factors, but extreme weather also comes into play.

Population is typically concentrated in native Alaskan villages and the use of satellite links for telephone communications in larger communities, and radio for smaller ones, is routine.

4.3.2 Case 6. Emergency coordination.

Again, the isolation of nodes creates special problems. Most emergencies are handled by the communities, and they draw on their own resources. This example draws on the real world, using the U.S. State of Alaska as its source.

In Alaska even larger communities use self-help, because time, as well as distance is critical. In temperatures ranging to 52 degrees below zero Fahrenheit, an injury may be further complicated by hypothermia or frostbite. Persons who are in good health are vulnerable to such injury if they are stranded by a vehicle failure.

Aircraft are widely used for emergency response, to carry responders or supplies, or to aid in searching for lost persons.

Major disasters, such as earthquakes or volcanic eruptions, both of which are not uncommon in Alaska, cause the government to become involved and mobilize resources from throughout the area. Military and paramilitary organizations are called into play, and another communications issue arises.

With multiple organizations using radio within range of each other, frequency coordination and spectrum allocation are important tasks. a balance must be maintained between allowing some normal communications to continue and serving the needs created by the emergency.

4.4 High size/high density

As noted in the introduction, this area is the most likely to use highly sophisticated methods of emergency communications.

Examples of this type of area would be most large cities. In the PTC area, cities like Singapore, Hong Kong, Tokyo, Sydney and Jakarta come to mind. The examples cited for the two cases are drawn from the U.S. experience, but similar examples could be found in other large cities.

4.4.1 Case 7. Emergency reporting.

The availability of telephone service is generally higher, making the telephone the most likely method of reporting emergencies.

In some areas of this type, brief dialling codes, typically of 3 digits, are used for emergency reporting. Depending on the sophistication of the telephone system, a caller may be automatically routed to the nearest emergency response coordination location, and, if individual line identification is possible, the caller's name and address may also be automatically delivered to the response coordinator.

This process is quite common in the United States, where the numbers 9-1-1 are utilized for direction of emergency calls. This number was initially designated by American Telephone and Telegraph (AT&T) in 1965, and subsequently in 1973 identified by the U.S. government, specifically the White House Office of Telecommunications Policy, as a means to easily handle emergency calls. (4)

When calls are routed, they are done using two common schemes. The first is called Basic 911 or B-911. It uses the originating exchange switch as the indicator of where to route the call. The problem with this approach is that the exchange switch serving area may not always match the boundaries of a police of fire jurisdiction. In the U.S., these jurisdictions are based on governmental units like cities, counties, towns and villages. An incident at or near a jurisdictional boundary may be responded to by units from several governmental agencies.

The second routing scheme, called Enhanced 911 or E911 is more precise. It utilizes the identification of the calling telephone to direct the call and search a database to provide the correct name and address.This has the added advantage of allowing responders to go to a location where a report has been begun, but terminated due to illness or injury. Lives have been saved by the use of this method.

In a recent study, conducted under the auspices of the National Emergency Number Association (NENA), 88.2% of U.S. cities over 100,000 population were identified as having Enhanced 911. When those currently planning to have Enhanced 911 were added to those already in service, the total rose to 99.4%. (5)

Clearly, for the larger cities, this means of emergency reporting is considered desirable. Note that physical location reporting requires some form of addressing, which can be a problem since address formats must be consistent.

Typically, areas of this type use a combination of transmission means. Fiber optic cable, copper cable, microwave and satellite are all utilized to deliver calls. In addition, the use of cellular telephones has expanded dramatically in the last few years. Experiments are underway to evaluate Personal Communications Networks (PCN) which will use radio and personal transmitters.

4.4.2 Case 8. Emergency coordination.

While U.S. 911 calls are routed by a variety of means, the reports are virtually all made over the public switched telephone network. By contrast, emergency response is almost always coordinated over the radio, although telephone links are used for secondary handling of an emergency report.

When an emergency call is delivered, it may be received by a variety of response organizations. Two major functions are provided in the emergency response center, typically caller a Public Safety Answering Point (PSAP). They are call taking, or receiving the report, and dispatch, or coordinating the response.Systems used to coordinate the response include maps, computer-based geographic databases, and radio. In some locations, data terminals have been placed in emergency vehicles. allowing more information to be sent to responders. Geographic vehicle location schemes are also used,allowing dispatch of the nearest unit to a specific emergency.

5. SOLUTIONS: The model was offered as a convenient framework to look at some typical areas, and to describe in a general way how they may report and coordinate emergencies, using telecommunications.

One truism is that no one person has all of the answers to a particular problem. As noted above, one purpose of this article is to allow PTC participants to look at a specific problem, and to open a forum for further discussions. The theoretical portions of the cases need to be expanded with further experience from PTC members. The area of emergency service telecommunications is specialized, and an excellent solution to a problem may not be transmitted beyond the area in which it is developed.

In the process of description, a variety of solutions were noted. At this point, a review of these solutions will be of use in order to better focus on their value.

5.1 Low size/low density

Solutions which are simple to use and easy to maintain can enhance both coordination and reporting. Advanced technology can be of help in improving communications.

5.2 Low size/high density.

Local capabilities may be adequate for common emergencies, but overwhelmed by major disasters. External expertise can be available with appropriate communications.

5.3 High size/low density

Isolation of nodes can be overcome by communications with a central support source. Non-physical means of communications prevail.

5.4 High size/high density

Wire communications are most common, and sophisticated, multiple media communications are commonly utilized. Reporting is by wire, and control is by radio.

5.5 General

In three of the four areas, non-wire communications are more commonly used. This reflects both demographic and developmental factors.

In areas where wire-based telecommunications have been deployed, the variety of solutions used includes the full range of technology in conjunction with wire-based applications.

By contrast, in the areas where non-physical means of total communications prevail, solutions tend to be implemented, and then rarely change over longer periods. Change is driven by the availability, cost and applicability of new technology.

6. CONCLUSIONS: It is clear that advanced telecommunications capabilities will continue to enhance emergency services communications. If cost were no object, the most isolated areas could be enabled to communicate with any other area on the planet. Technology is rapidly changing the telecommunications environment, and continues to allow more flexible means of communications to be deployed at lower cost and higher reliability.

The challenge for emergency services

telecommunications management is to identify, select and deploy the mix of technology that is most appropriate for each area within its area of responsibility. The issues of appropriations, maintainability, and affordability differ for each application, but to make the most informed choice, data must be available on systems in each of these areas.

The model discussed in this paper has allowed descriptions of need in a most general fashion. What is needed next is a forum for specialists in emergency services telecommunications.

FOOTNOTES

1. "Desert Storm serves voice, data, video via mobile satelite system" Communications News, September 1991, P.26.

2. "Telecomm must be involved in safety of human life", Tarjanne, Pekka, quoted in Communications News, October 1991, p.6.

3. Tarjanne, op.cit.

4. "Making Rescues Happen", Myers, Michael D., Telephone Engineer and Management, September 1,1991, pp. 63-67.

5. 9-1-1 Status, U.S. Cities over 100,000 Population (Ranked According to 1990 Census), as of June 1991. Study prepared by Mr. Ken Keim of the Oregon 9-1-1 Program. Provided by Mr. William Stanton, Executive Director, National Emergency Number Association (NENA).

GLOBALSTAR: Mobile Communications From Wherever You Are

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GLOBALSTAR is a satellite-based communications system that will provide mobile voice and data service as well as positioning service to users worldwide. It will allow users to make telephone calls with mobile and hand-held telephones from anywhere to anywhere -- and even routes calls through existing public and private telephone networks. GLOBALSTAR is a concept from Loral Cellular Systems Corporation, a new company formed by Loral Corporation and Qualcomm, Inc. These two companies bring unparalleled expertise in aerospace systems and ground communications technologies. Working together, they will join with limited partners to provide radio-determination satellite services (RDSS), and voice and data communications to users around the world.

1.0 SUMMARY

GLOBALSTAR enhances worldwide mobile services using a constellation of low earth orbiting satellites. The key feature of this system is its ability to offer low-cost, high quality and flexible services not currently available in areas not economical to serve terrestrially. It utilizes existing public and/or private network facilities to extend mobile user's Global connectivity. GLOBALSTAR subscribers will be able to communicate wherever and whenever they happen to be. Furthermore, such operation is deemed to be both profitable and low risk.

2.0 INTRODUCTION

On June 3, 1991, Loral Cellular Systems Corporation (LCSC) filed an application with the U.S. Federal Communications Commission for authority to construct a "GLOBALSTAR" system providing Radio Determination Satellite Services (RDSS) and Mobile Satellite voice and data services (MSS). Domestic operation within the United States is expected to begin in 1997. This paper will first give a general system overview, and then describe service offerings, ownership and revenue sharing, and expected revenue potential. GLOBALSTAR subscribers can expect highly reliable and yet low-cost mobile services to satisfy their communications needs.

3.0 SYSTEM OVERVIEW

The GLOBALSTAR system employs a constellation of 24 or 48 low earth orbiting satellites operating in conjunction with public switched telephone networks and/or specialized communications networks. The number of satellites depends on utilization of the system by various worldwide communications distributors. Each satellite has a capacity of over 2,600 duplex voice circuits and can also perform position determination at a rate of 17 million locations per hour. A bandwidth of 16.5 MHz in the L-band (1610.0-1626.5 MHz) is assigned to the satellite-user links while that of 33 MHz in the C-band (5199.5-5216.0 MHz & 6525.06541.5 MHz) is used for satellite-gateway or feeder links. Using compact and portable transceivers, subscribers can perform position determination and make local, long distance, and/or mobile to mobile calls by connecting through gateways and network facilities owned by various service providers. As shown in Figure 1, the entire network is divided into three segments: space, user, and ground as described below:

3.1 SPACE SEGMENT

A constellation of 48 LEO satellites in circular orbits at an altitude of 1,389 km (750 nautical miles) provides extended global coverage. These 48 satellites will be launched into eight orbital planes, with six satellites in each plane. Each orbital plane has an inclination angle of 52 degrees and each satellite has a 7.5 degree phase shift to the satellite in the adjacent orbital plane. Over the United States, such a constellation will guarantee full coverage with a minimum of three satellites in view as depicted in Figure 2. Satellites rise in the west and travel alternatively northeast and southeast with a period of about two hours. The average connection time for a user to a single satellite is about ten minutes. In the course of a phone call, the "make" and "break" user-satellite connections are carried out routinely and transparently according to a well-defined handoff procedure. Each body-stabilized satellite is equipped with a simple "bent pipe" transponder and an antenna having six elliptically shaped spot beams. This payload design approach allows GLOBALSTAR to adopt to many different global mobile system standards and avoids the use of complex on-board signal processing and satellite crosslinks. Spread spectrum modulation and Code Division Multiple Access technique will permit frequency reuse 288 times globally. In the L-band, the satellite delivers an EIRP of 29.8 dBW and has an G/T of -12 dB/K. Similarly, in the C-band, the EIRP and G/T is 10.4 dBW

and -20.4 dB/K, respectively. The satellite mass at launch is 265 kg, including 43 kg of fuel to support orbit insertion and an in-orbit life of seven and a half years.

3.2 USER SEGMENT

Transceivers may be handheld or vehicle-mounted units. They may be of simple mode design suitable for satellite RDSS/voice plus data operations. However, the most likely case would be dual mode units allowing the user to move freely between the terrestrial system and the satellite coverage area. Each of these units consumes less than one watt of average DC power and is equipped with a variable speed vocoder and an omni-directional antenna.

3.3 GROUND SEGMENT

3.3.1 GATEWAY STATIONS

Each station is equipped with two 2-meter C-band tracking antennas capable of transmitting an EIRP over a range of 32 to 44 dbW and having a receive G/T of 14.6 dB/K. During routine operation each station executes handoff procedures between satellites and between beams. The RDSS functions are performed either at the gateway stations or at the user terminal, while voice/data are routed through the gateways. Gateways equipment is designed to be added to existing cellular terrestrial facilities thereby sharing the switch.

3.3.2 NETWORK CONTROL CENTER

The NCC will perform registration, verification, billing, network data distribution, resource allocation, and other network management functions.

3.3.3. TERRESTRIAL-BASED NETWORK

The Public Switched Telephone Network (PSTN), the Public Land Mobile Network (PLMN) and other private and specialized networks are integrated into the system by means of the gateways. Connections are provided in the normal manner.

4.0 GLOBALSTAR SERVICES

GLOBALSTAR not only offers new and cost effective services, but also enhances existing terrestrial-based cellular telephone services. Included are: RDSS at the user's locale, in the user's moving vehicle, or at a remote site; services into areas not covered by terrestrial cellular and mobile systems; and global messaging, voice mail and other services. The front line of services is Radio Determination, Voice and Data.

4.1 WIRELESS MOBILE RDSS

The first service in this category is passive position determination where the user's position is computed by the user terminal itself. Applications for this service include emergency services, as well as recreational activities such as backpacking and boating. This service will be provided free at no charge to the user. The second is remote RDSS where the position of the user is requested. Its position is gateway computed and communicated to the user transceiver or to another third party. This service may be used in emergencies where the user needs to communicate his whereabouts to rescuers. The third is interrogating or tracking where a caller may request the gateway to communicate with a particular subscriber. Applications of this service include locating fleet vehicles, tracking hazardous waste shipments, monitoring military movements and locating stolen vehicles. All of the above RDSS functions in general may be combined with paging and messaging.

4.2 WIRELESS MOBILE VOICE AND DATA SERVICE

This service is provided to: (a) mobile or fixed users working and/or living in areas without terrestrial coverage, including subscribers traveling from one area to the other; and (b) private or specialized network operators including governmental agencies, commercial users, managers of fleet vehicles, emergency service providers, etc. Commercial users include rural facilities which are currently excluded by the PSTN or cellular network, utilities which require regular but infrequent asset monitoring, and security and resource management systems.

4.3 QUALITY OF SERVICE

The RDSS attains an accuracy of 300 meters for 80% of the time and less than 1,600 meters (one mile) all the time. Mobile voice is provided at "near toll" quality which surpasses that offered by the terrestrial based cellular. Bit Error Rate performance for 2400 bps data service is expected to be better than 10^{-6}.

5.0 OWNERSHIP AND REVENUE SHARING

LCSC will own and operate the network on a non-common carrier basis. It plans to form GLOBALSTAR Limited Partnership to raise capital and other resources for the construction of the System. Within this arrangement, partners will be able to make whole sale purchases of the satellite capacity and then retail the services directly to end users. For high reliability and low cost, the GLOBALSTAR system uses a large number of gateways in

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order to optimize the usage of the existing network infrastructure. Service rates are therefore lower since capital expenditure and operating expenses are minimized. In addition, the low-cost gateway equipment is specially designed to be adopted to the terrestrial network equipment providing interconnection services. Participating carrier operators therefore will have ample incentives to adopt GLOBALSTAR services rapidly as a means of expanding their own service reach and capability to increase revenues and profits.

6.0 FINANCIAL PLAN

An income projection based on a business scenario [1] indicates that the revenue will grow from $141M in 1997 to $673M in 2006. This scenario was formulated according to a number of factors including the market demand, user equipment costs, service rates, capital investment and operating expenses, which are addressed below:

A conservative estimate of the urban and the rural users of satellite service from 1991 through 2006 is given in Tables 1 and 2, respectively. Data indicates that from 1991 to 2006 the satellite users in U.S. urban counties will grow fourfold, from a quarter of a million to 1.05 million. Similarly, U.S. rural users will increase close to fivefold from 560,000 to 2,620,000. For the RDSS market, predicted demand for position and/or messaging services is 2.6 million units in 1996, 3.4 million in 2000, and 4.2 million units in 2006. The premise behind this market forecast is GLOBALSTAR's ability to offer enhanced services with an attractive rates matching the terrestrial cellular (at $40 a month for a typical user averaging 100 call-minutes). It is expected that cellular rates will decline from current average rate of $80 per month to $40 per month during the system's life time. In addition, this market model takes into account not only the regional population growth but also its economic well being since the demand for mobile services is found to be related to potential subscribers's willingness to pay [2], which in turn depends on availability, quality, and price of the service offerings. The costs for the construction, launch and operations of 48 satellites in the first year is estimated to be at $829 million [1].

7.0 CONCLUSION

GLOBALSTAR offers a practical enhancement of mobile communications. Key system design features such as simple bent pipe transponder, open architecture, single satellite use by a user have been implemented in order to allow ease of adopting the system to existing networks for flexibility and quality performance. Its services are affordable. Its operation is profitable. More importantly, implementation of GLOBALSTAR promotes international cooperation.

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[1] Loral Cellular Systems Corp., "Application before the Federal Communications Commission for Authority to construct A Low Earth Orbiting Satellite System," June 3, 1991;

[2] Herschel Shosteck Associates, "An Analysis of the Demand for MSS & RDSS Services," Prepared for Space Systems/LORAL, May 1991.

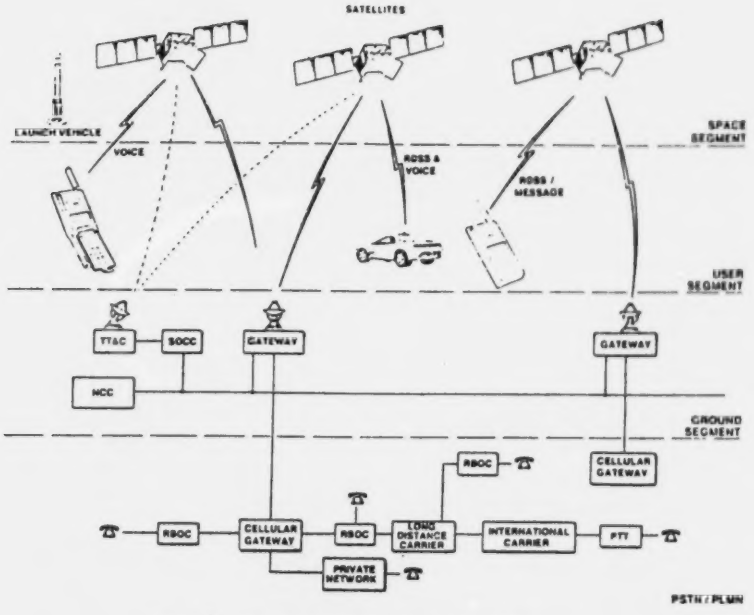

Figure 1. The GLOBALSTAR System Elements

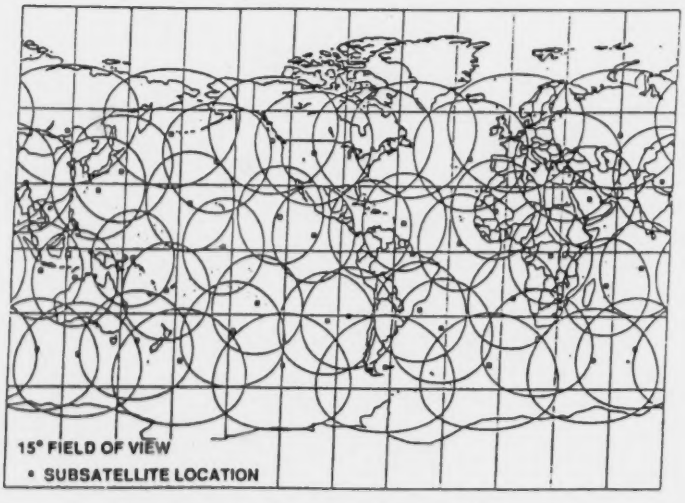

Figure 2. Global Coverage of 48 Satellite Constellation

TELECOM EQUIPMENT REMARKETING: A WINNING EFFORT

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ABSTRACT

In recent years, the worldwide demand for secondary telecommunications equipment has grown dramatically. We must continue to aggressively investigate the global markets in search of new ways to "Connect the World".

It is important for PTC members to be made aware of the size, scope, and operation of the secondary market for telecommunications equipment and how it could affect their businesses. The secondary market is already growing at a fast pace in the United States. The domestic market is projected to grow at an annual rate of fifteen percent (15%) from $530 million in 1990 to $1,066 billion in 1995. The international market is beginning to emerge and is expected to eclipse the domestic market within the aforementioned forecast period.

The secondary market consists of end-users, distributors and telephone companies who need a continuous supply of quality equipment for their current communication requirements at an attractive price.

The secondary market provides reasonable features and continued parts supply, as well as an alternative source for price, service & quality. This market is also an avenue to service authorized "new equipment manufacturer's distributors", such as International PT&T's and interconnects, who require equipment to service an existing installed base that can longer be provided due to obsolentity or scarcity.

A&A Connections, Inc. is leading the way in developing International trade in the secondary telecommunications market. Our goal is to organize the market place in order to provide an answer for improving the telecommunications facilities in lesser developed countries worldwide.

PTC consists of major users, user associates, manufactures, suppliers, distributors, and service companies; all of which require the maintenance of an orderly market for surplus, used, and refurbished products. Such support is critical for stabilizing residual values in communications systems investments made by end-users.

Manufactures express concerns about the impact of used products on new system sales. Surplus and used equipment suppliers claim that their total market represents less than (1%) of new annual sales and feel that these manufacturers' concerns are exaggerated. Users and secondary market suppliers believe that this exaggerated fear occurs as a result of the manufactures failure to adequately maintain their distribution channels. If manufactures organized their distribution network to better accommodate end-users' needs for used and refurbished equipment through established and authorized channel outlets, the erosion of the customer base (maintenance, adds/moves/changes, and after sales service) could be stabilized.

Manufacturers and their distributors endorsing both new and refurbished equipment enhances the commitment to serving end-users for the long term. Used equipment will grant those users who are unable to afford the newest products, such as in lesser developed regions, or end-users who may not need the newest technology a viable alternative until the newer products make practical sense.

There is enormous opportunity for used and refurbished equipment to become an integral product mix for manufacturers, distributors and secondary marketers. If efforts were combined in an organized market place, complete support of equipment would be guaranteed. The result would be long term, end-user satisfaction.

For a winning effort to be achieved, the secondary market supplier must be considered an invaluable player in the telecom industry.

COMPETITION SAFEGUARDS IN TELECOMMUNICATIONS: AN ISSUES PAPER OF THE INFORMATION TECHNOLOGY ASSOCIATION OF AMERICA

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1. ABSTRACT

The worldwide information technology (IT) industry, a primary engine of global economic growth, depends on the output of a related industry, telecommunications, to reach its customers. Telecommunications Operators (TOs) are becoming potential competitors in IT by offering value-added data services and systems integration services. Where TOs enter the information technology services marketplace, competition (or antitrust) policy must be implemented to address the incentive that the TOs have to compete unfairly. Competitive safeguards typically address the structure of monopoly TOs, through creation of a fully separated subsidiary, or the TO's conduct, through cost accounting rules and tariffs. Debate and discussion around the world show that, although tradeoffs will be resolved differently in different national and regional contexts, the issues are indeed universal.

2. INTRODUCTION

The worldwide information technology (IT) industry has become a primary engine of global economic growth. For 1990, worldwide information services expenditures were estimated at US$200 billion, and information systems (including hardware) at US$865 billion (both figures exclude telecommunications revenues). For 1995, these numbers are forecast to rise to US$420 billion and US$1.5 trillion, respectively. North America, despite the highest market penetration, still enjoys a compound annual growth rate of 13%, while Europe and Asia stand at 19%.[1] There are now about 100 million personal computers installed worldwide, or one for every 50 people.[2] In country after country, policy makers are encouraging their nation to develop a strong footing in IT, whether in mainframe or personal computers, semiconductor chips, software, or computer and communications services. IT is being seen more and more as "strategic" or "critical" for national economic performance and worldwide economic competitiveness.

The IT industry relies on the output of a related industry, telecommunications, to reach its customers and meet their information needs with maximum efficiency. While the two are generally spoken of as recognizably separate industries, the nexus between them in data communications continues to raise intricate policy and regulatory questions.

Despite strong trends towards competition, basic telecommunications services that are provided over monopoly-held telecommunications infrastructure facilities -- both voice and data -- remain a controlled market in most countries. Generally, telecommunications services are reserved to government-franchised telecommunications operators (TOs),[3] often monopoly enterprises. Where competition is allowed, it is usually regulated or limited so as to further public policy objectives. Thus, worldwide, the IT industry must rely on underlying TO services to reach its customers. Without these underlying telecom capabilities, many computer and information services firms would be unable to provide their services efficiently and effectively.

Many ITAA member companies offer data processing and other IT services globally, using international telecommunications networks. Despite competition from TOs, IT services companies still must rely on the TOs to supply them with underlying data and voice transport. Where such competition between TOs and independent IT services providers does occur, competition (or antitrust) policy must be implemented to address the incentive that the TOs have to compete unfairly:

- by providing their own operations preferential access to telecommunications capabilities; or
- by using revenues from the underlying monopoly telecommunications services to subsidize the provision of competitive value-added services.

Precluding TOs from entering competitive lines of business may be unrealistic. Thus, the use of other mechanisms or safeguards -- including structural separation requirements, nonstructural behavioral safeguards regulation, and the ability to resell TO-provided monopoly services -- should be considered to ensure that all providers of competitive services have a fair chance to succeed. ITAA commends the detailed position statements on telecommunications competition and safeguards issued by the International Chamber of Commerce as a prominent statement from world business on the subject.[4]

This paper examines the various regulatory options which have been considered and tried in countries seeking to ensure fair and open competition in the value-added communications and information technology market. ITAA hopes that this discussion paper will accomplish two major goals:

- promote the application of competition (or antitrust) policy principles in telecommunications policy development; and

- motivate the international IT services industry to advocate such policy development to protect its unique interests in this area.

By drawing from the debates and decisions about the intersection of competition and telecommunications policy in various countries, ITAA hopes to further the international debate and to ensure that TOs and computer services vendors can make their respective contributions to economic progress through information technology.

ITAA represents more than 550 firms offering a wide array of services, including those based on the use of telecommunications networks, such as cash consolidation and financial management services; computer-aided design and manufacturing (CAD/CAM); computer reservation services; credit-card verification; electronic data interchange; electronic funds transfer; electronic mail; and payroll processing.

While almost all of ITAA's members are based in the United States, the Association has taken a lead role in promoting its industry worldwide through the World Computing Services Industry Forum, now comprising 23 national associations. In conjunction with some of these other bodies, ITAA sponsors the biennial World Congress of Computing Services.

3. THE NEED FOR COMPETITIVE SAFEGUARDS

For the foreseeable future, IT services companies, will remain dependent on TO transmission, whether by leased lines or public switched services, to reach their customers, whose data they are to process or deliver. Specifically, independent vendors need switched and dedicated TO services with all of the following characteristics: two-way; very low error rate; highly reliable (uptime); ubiquitous; reasonably priced; consistently provisioned; and having standard interfaces for user equipment.

ITAA last year submitted the results of a survey to the U.S. District Court that administers the AT&T Consent Decree. The survey showed that major ITAA members -- most of which operate internationally -- are still 99%-plus reliant on TOs in the U.S. to reach their customers. Indeed, as computer and information services move to higher speeds, fiberoptic cable and other digital media, almost always owned and operated by TOs, will be the medium not of choice but of necessity.

As long as this dependency relationship exists, there will be a need for competitive safeguards. Generically, safeguards are provisions of law, or regulations having the force of law, constraining the conduct of monopoly firms so as to reduce greatly the possibility of anticompetitive conduct.

This section will describe the specific need for safeguards by listing the different ways in which TOs have used, or can use, their franchised monopoly position unfairly to advantage their own competitive service offerings at the expense of competitors. Generally speaking, the service offerings provided by TOs and used by computer and information service vendors are leased-lines (or equivalent), public switched dialup, and public data network services.

Published TO tariffs could incorporate many of these safeguards. In particular, information disclosure, unbundling, and resale[5] could easily be incorporated into a tariff rather than, or in addition to, some other regulatory measure. As long as all changes must be publicly reviewed and approved, incorporation of safeguards into tariffs may be preferred, because it provides users with a comprehensive reference document. The form and manner of implementing safeguards may differ from country to country for various reasons, and this issues paper concentrates on the content, rather than form or manner of implementation, of the safeguards.

3.1 DISCRIMINATORY ACCESS TO RESERVED SERVICES AND INFRASTRUCTURES

TOs can bundle their service offerings so as to create an "all or nothing" package for users including IT companies, forcing them to buy features they do not want or need so as to obtain the ones they do want. Providing itself with unbundled services can allow the TO to offer flexible service offerings **at a lower price** when competing in the IT services market.

TOs can give their own operations superior network access in terms of features, functionality, transmission quality, and reliability, and provide its own operations with superior or more prompt installation, maintenance, and repairs.

3.2 PRICES, TERMS, AND CONDITIONS

A TO typically is required to establish and publish tariff rates for its monopoly facilities and services at levels that cover costs and provide an appropriate return on investment. It might charge its customers these tariffed rates, while providing its own competitive enterprise the same facilities and services at cost or below.

Through a lease contract, a TO could impose less favorable terms and conditions on its competitors that are not imposed on itself or its own affiliate, when providing a competitive service. Such terms might relate to price, length of contract, rights of renewal, maintenance and repair, and circuit quality.

3.3 DISCLOSURE OF NETWORK INFORMATION

TOs can fail to disclose technical information needed for effective interconnection with, or use of, the public telecommunications network.

TOs can withhold technical information until the introduction of their own competitive services, thereby preventing competitors from developing a timely marketing strategy to compete with the new TO service.

TOs can use proprietary network information, not available to their competitors, to develop new service offerings.

TOs can withhold business-related information about subscribers or can require subscriber consent[6] before releasing such subscriber information to independent vendors, while using that data in its own marketing efforts. Such subscriber-related data may include touch-tone phone ownership or detailed call reporting data.

3.4 CROSS-SUBSIDIES

TOs can use protected revenues from monopoly services to lower prices artificially in competitive services, through misallocation of joint and common costs. Such predation could succeed in driving less well-funded competitors out of the market.

3.5 EXISTING ANTITRUST AND COMPETITION LAW REMEDIES AFFORD ONLY AFTER-THE-FACT RELIEF, NOT PREVENTION

In countries where TOs may be treated as regular commercial entities for the purposes of antitrust or competition law, the same remedies are technically available against them as against other companies engaging in anticompetitive conduct. Thus, a private party, as well as a government body, could bring an action to stop the offending practice and to seek monetary damages to compensate for lost profits. However, long and expensive antitrust litigation is not suitable or practical protection. What is needed is specific legislative or regulatory safeguards designed to **prevent** competitive injury, rather than **remedy** it after the fact.

Such regulation is desirable because a smaller, aggrieved party suffers a disadvantage if forced to seek antitrust relief in the courts against a larger, better-financed party. By the time a smaller company succeeded in obtaining a judgment, he might well have been forced out of business. When the larger party is a part of the government itself, as many TOs are, the odds become even more formidable. Sound public policy should be fully developed, so that all competitors are treated fairly, not just the ones able or willing to resort to legal recourse.

4. ANALYSIS OF ALTERNATIVE SAFEGUARDS

This section describes the benefits and potential negative consequences (costs) of various safeguard options.

4.1 EXCLUSIONARY RULE PREVENTING TOs FROM ENTERING COMPETITIVE LINES OF BUSINESS

The most far-reaching way to prevent anticompetitive activity by a TO is to prevent it from offering competitive services in the first place, either through legislation or, as in the U.S., through a judicial decree. The objective is to remove the very source of anticompetitive conduct: the TO's ability and incentive to take advantage of competitors, stemming from the simultaneous operation of monopoly and competitive services.

Benefits. This is the surest way to preclude anticompetitive conduct.

Costs. There is potential loss to the market of TO expertise, scale and scope economies.

4.2. STRUCTURAL SAFEGUARDS, BY WHICH A TO, UNDER GOVERNMENT MANDATE, CREATES A FULLY SEPARATED SUBSIDIARY BEFORE ENTERING COMPETITIVE LINES OF BUSINESS, WITH SPECIFIC CONTROLS ON DEALINGS BETWEEN THE TO AND ITS COMPETITIVE SUBSIDIARY

The need for competitive safeguards is relevant whether or not the TO provides monopoly and competitive services in structurally separate, arm's-length entities, or on an integrated basis within a single organizational entity. Under structural separation, implementation of the safeguards may be simplified to the extent that activities are kept separate. Separate activities are easier to monitor, and most importantly, the needs of the separate competitive company will drive the monopoly to provide appropriate services to all competitors on fair and equal terms. The choice between requiring structural separation and allowing integration is a matter for the independent regulatory authority to decide, based on national circumstances and preferences.

Generally speaking, the U.S. Federal Communications Commission has found that a separate subsidiary must meet a number of requirements:

- have separate officers and employ its own personnel;
- maintain separate books of account;
- utilize its own facilities;
- secure its own debt financing;
- obtain all transmission capacity from affiliated carriers pursuant to the terms and conditions appearing in the carrier's published tariffs (or if service is provided pursuant to contract, at the same rates, terms, conditions that such service is provided to third parties);
- conduct all transactions with affiliated carriers, other than those involving tariffed transmission services, on an arm's-length basis pursuant to written contracts; and
- acquire all research and development services and equipment from affiliates on a fully allocated cost basis.

Benefits. This alternative eliminates most joint and common costs, thus reducing the opportunities for cross-subsidization; exposes dealings between parent TO and affiliate to inspection so as to prevent more favorable terms being offered to the affiliate than to independent IT services vendors, therefore constraining the TO to deal with affiliate in the same way that it deals with all other parties.

Costs. The TO must accept the costs of running a separate corporation, with separate facilities and staff. Some economies may be lost.

4.3. NONSTRUCTURAL SAFEGUARDS CONSISTING OF REGULATORY REQUIREMENTS ENFORCED BY AN AGENCY INDEPENDENT OF THE TO

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4.3.1 ACCOUNTING RULES. The TO can gain an unfair advantage over its competitors unless proper cost allocation and accounting procedures are in place to identify and assign costs to the TO's monopoly or competitive enterprises. The TO can gain an unfair advantage by overallocating operational costs and improperly assigning investment risks to the monopoly activity, where recoupment is virtually assured. This activity provides market-distorting benefits to the TO's competitive affiliate by underallocating the costs and risks of its competitive activities where the vicissitudes of the competitive marketplace provide no assurance of recoupment. Thus, accounting safeguards are generally designed to help detect any attempt by a TO to shift the costs of the nonregulated enterprise to regulated activities.

An effective cost allocation and accounting system should be designed to account for the monopoly and competitive offerings of a TO as if the two were offered by unaffiliated entities. All TO offerings should therefore be categorized as either monopoly or competitive, with books of account providing complete and separate financial statements for each. Accounting principles and rules should be promulgated properly to identify and assign to each the appropriate costs, revenues, assets, and liabilities.

This approach not only reduces the potential for improper cross-subsidization, but also facilitates the development of a detailed accounting system that can provide the full range of data needed for cost-based tariff offerings. Cost allocation and accounting systems should incorporate the following principles.

Cost Allocation. All recorded historical costs should be allocated between monopoly and competitive activities using a fully-distributed costing (FDC) method rather than incremental costing methods. The FDC method assigns an appropriate portion of all investment and expenses -- both direct and indirect or overhead -- incurred in conducting these activities. Costs should be directly assigned to one or the other activity based on cost causation. Common costs that cannot be directly assigned should be apportioned between monopoly and competitive activities using the most precise allocator available, typically the ratio in which directly assigned costs are recorded. The method of allocation used should minimize subjective judgment and facilitate objective review.

Assignment of Investment Risk. All of the risk for capital investment should not be borne by the monopoly ratepayer when assets are acquired and used jointly for providing both monopoly and competitive services. The TO should apportion the asset value of the jointly used equipment, at time of acquisition, to the books of the monopoly activity and to the books of the competitive activity respectively on the basis of peak forecast use by the competitive activity as projected over the depreciable service life of the asset.

Transactions With Affiliated Entities. Whenever the TO's monopoly activity sells to, or purchases from, the competitive activity, the price of the transaction should be based on the net book cost or should reflect fair market value. If the monopoly buys from the affiliate, the transaction must be accounted for at the lower of fair market value or net book cost. If the transaction is a sale from the monopoly to the competitive side, it must be accounted for at the higher of fair market value or net book cost. This practice is intended to avoid having the monopoly activity purchase assets with monopoly revenue merely to transfer them to the competitive activity at an advantageous price, thus harming both the monopoly ratepayers who bear the burden of the purchase, and the competitors of the TO's competitive activity, who have to pay full price for comparable assets.

Employee Designations. The preferred method of allocating salary expenses between monopoly and competitive activities when TO employees work in both areas is by predesignating each employee to one or the other enterprise. Then, "exception time reporting" can be used to account for time spent on the other activity. In the absence of predesignation, each employee would have to account for time on an hour-by-hour basis, a time-consuming and less practical method when thousands of employees may be involved.

Accounting Procedure. A formal system of internal control should be established to compile the necessary documentation for an effective accounting system, producing separate books of account for the monopoly and competitive activities respectively, and ensuring the credibility of the accounting procedure.

Compliance Audit. The TO should file annually with its regulatory authority an opinion obtained from independent auditors that the TO is complying with cost allocations and accounting plan.

Benefits. Rules such as fully distributed costing (FDC), described above, help to prevent TOs from ignoring or concealing some costs altogether, or from misallocating costs away from competitive services to reserved services, so as to prevent predation through cross-subsidized pricing.

Costs. In many instances, cost allocations are ultimately arbitrary; compliance can be burdensome; and regulatory agencies will almost certainly be understaffed for review purposes relative to the tariffing and accounting departments of TOs, which are larger organizations.

4.3.2 REGULATORY SAFEGUARDS

If the responsibility for the provision of monopoly services and for regulatory oversight is vested in the same entity, the potential exists for a conflict of interest in the process of developing, approving, and implementing competitive safeguards and other regulatory requirements. Therefore, all regulatory safeguards should be administered by an independent governmental authority with responsibility for overseeing the monopoly activities of the TO. In addition, this authority should provide an appeals function to settle disputes that may arise between a TO and its competitors or customers that cannot be settled between the parties themselves. So as to avoid conflict of interest, this authority should be independent of the TO organizationally, financially, and legally. Any party with a grievance -- user, competitor, or TO -- should be permitted to bring a case before the authority.

Rules governing the provision of access to the TO's facilities and services, and prices to preclude discrimination against competitors by TOs.

Generally speaking, these rules require a TO to provide its information service competitors with access to regulated services and facilities at the same rates,

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terms and conditions that such services and facilities are made available to its own information service operations. These rules also apply to the TO's provision of installation, maintenance and repair services.

Benefits. TOs are prevented from treating affiliates advantageously relative to independent competitors.

Costs. TOs remain free to favor affiliates in new ways that are not specifically prohibited. It may be very difficult to ascertain whether a TO is complying with its obligation to provide equal service, and in services such as data communications, even a very small variation in quality can make a major marketplace difference.

Information disclosure rules as to technical specifications and customer usage data, so that such data are provided to competitors at the same time, and on the same terms and conditions, as to a TO affiliate, if at all.

With regard to technical data, the TO routinely plans and implements technical changes to the network infrastructure for upgrading capacity and function. All competitors rely on this infrastructure to provide their services. If all competitors are not made aware of the network changes with sufficient advance notice to adjust their service offerings, the TO's competitive activity would be unfairly advantaged. Therefore, the TO must publicly disclose technical information on network changes, including changes to network interfaces, that affects the provision of competitive services or the attachment of customer premises equipment with sufficient lead time to permit competitive service providers and equipment manufacturers to adjust their offerings accordingly. As mentioned before, customer data includes, for example, touch-tone phone or detailed call reporting.

Benefits. These rules prevent a TO and its affiliates from withholding information in its possession, solely as a consequence of its monopoly franchise, so as to disadvantage competitors.

Costs. TOs may be compelled to release technical information prematurely; some customers may prefer that data about them not leave the TO to go to any party, including a TO affiliate. (Relevant data protection regulations or self-regulatory policies of the TO may address this concern.)

4.3.4 RIGHT OF (NON-TO) LESSOR TO RESELL CAPACITY IN LEASED FULL-PERIOD CIRCUITS

Benefits. Permitting arbitrage undercuts a TO's ability to charge anticompetitive, non-cost-based rates.

Costs. Resale may also undercut cost averaging sanctioned as a matter of social policy to keep rates down for rural or isolated customers.

4.3.5 UNBUNDLING REQUIREMENTS

Most fundamentally, these rules generally require TOs to segregate (or "unbundle"), and make separately available, the transmission capacity underlying their information service offerings. Moreover, under open network policies[8], underlying discrete basic service elements are to be unbundled, each separately available under tariff.[9]

Benefits. Unbundling permits users to acquire and pay for only those services which they want and need and allows competitors to acquire the underlying transmission service needed to offer services comparable to those of the TO.

Costs. Unbundling may deprive a TO of marketplace flexibility.

5. CASE STUDIES: UNITED STATES, EUROPEAN COMMUNITY, AND JAPAN

This narrative section describes the approaches taken by political entities having the greatest experience to date with competitive safeguards: the U.S., the EC, and Japan. It concludes with shorter descriptions of relevant activities in several other jurisdictions.

5.1 UNITED STATES

The interplay of antitrust law and telecommunications policy has occurred in the U.S. in a way not likely to be repeated in other countries. However, the fundamental issues of control of monopoly conduct are the same, and the early inception of new transmission technologies has forced the weighing of the public policy questions which this issues paper discusses. TOs in the U.S. have long operated as private shareholder-owned, but publicly regulated, utilities. As regulated entities, these TOs are under common carrier obligations to provide nondiscriminatory service to all who desire it at tariffed rates. The former AT&T's monopoly for long-distance (as opposed to local) service was de facto only and not a matter of exclusive government concession. Thus, technological progress, in the form of low-cost microwave transmission, created an opening for the competitive offering of long-distance telephone services.

Once a competitor, MCI, entered the long-distance market with microwave facilities on high-volume routes, AT&T was claimed to have competed unfairly by providing MCI with poor-quality connections to its local loops. MCI succeeded in obtaining private antitrust relief through the federal courts. At the same time, the U.S. Department of Justice, in seeking structural relief in court, presented so much damaging evidence of other anticompetitive conduct that AT&T agreed in January 1982 to be divested of its local operations as of January 1, 1984. The U.S. District Court handling the case held public proceedings as to the terms of the decree to end the government's antitrust action and issued a Modified Final Judgment in the summer of 1982.[10] The newly divested Regional Bell Operating Companies (RBOCs)[11] were to retain their local service monopolies, antitrust considerations remained a factor.

To prevent reoccurrence of anticompetitive conduct, parties agreed in 1982 to exclude the RBOCs from three core lines of business:

- long-distance transmission service;
- telecommunications equipment manufacturing; and
- information services, defined in a manner similar to enhanced services under the FCC definition.[12]

The rationale for the line-of-business exclusion was the same as that of divestiture itself. The monopoly TO -- which has bottleneck control of the local exchange facilities essential to the provision of competitive value-added services -- inevitably has the ability and the incentive to compete unfairly. Despite much debate, litigation, and legislation considered by the U.S. Congress, those restrictions on RBOC TOs have remained largely in place today. RBOCs have been allowed to enter these businesses on a case-by-case basis, only to the extent that they could obtain specific waivers from the MFJ court, contingent upon convincing the judge that such entry would not have a significant anticompetitive effect.

ITAA appreciates that an exclusionary rule will have less appeal in other countries where the TO plays a more integral role in social and industrial policy. Based on the proven record of abuses, both past and recent, however, ITAA has supported the U.S. exclusionary rule for information services[13] while being willing to consider the use of structural safeguards -- that is, requiring entry through separate subsidiaries -- as an alternative.

The consent decree litigation has become too complex to be worth retelling in full, but essentially every substantive and procedural issue has been contested and every decision appealed. The federal judge in charge has decided, interpreting a strict legal instruction from a higher court and expressly against his own judgment, to lift the information services restriction on the RBOCs. At the same time, he stayed that order pending appeal. The RBOCs successfully appealed the stay, and the further appeal by opposition IT services groups to the Supreme Court was unavailing. Thus, today the RBOCs are free to enter the IT services business in the U.S., with few restraints. The MFJ now requires only that their information services activities not involve long-distance services, except pursuant to any waiver. As discussed below, existing regulatory requirements have not proved satisfactory to IT services groups. IT services groups are continuing to appeal the district court's ruling on its merits, as the judge anticipated.

Proceeding in historical parallel have been the regulatory efforts of the Federal Communications Commission (FCC) in its three Computer Inquiries, dating to the 1970s. These proceedings were occasioned by the regulatory need to determine where the FCC's authority over telecommunications, under the U.S. Communications Act of 1934, ended and where the competitive offering of computer services started. The agency has followed the guiding principle that it should regulate as little as possible and leave as much to market forces as possible. This distinction emerged as a fundamental concept:

- "Basic"[14] services, narrowly defined, that TOs must offer under tariff in performance of common carrier obligations,[15] essentially voice and data transport; and

- "Enhanced"[16] services, broadly defined, up to and including protocol conversion, to be offered on a competitive, unregulated, free-enterprise basis as companies choose, subject to carrier compliance with FCC-specified competitive safeguards.

In its 1982 Computer II decision, the FCC required AT&T to offer enhanced services through a separate subsidiary. After divestiture, that rule carried over to the new Bell TO companies, which found this requirement burdensome and sought its removal. The FCC reversed itself in its 1985 Computer III decision, agreeing with the Bell Companies and substituting nonstructural safeguards instead. It was here that the FCC first adopted the concept of Open Network Architecture (ONA) as one of the substitutes for the protection of fully separated subsidiaries, along with cost accounting standards and other regulatory requirements. It was here also that the FCC allowed RBOCs to offer Comparably Efficient Interconnection (CEI) as an interim measure until the approval of ONA plans.

ITAA took the view, as did most of industry outside of the Bell Companies, that the FCC had not established a basis for its policy reversal. The federal court reviewing the decision recently agreed, reversing that part of the decision as a matter of administrative law. Even so, the FCC is proposing to maintain the nonstructural safeguard approach in its latest Computer Inquiry proceeding.

While the ONA concept has merit, ITAA -- joined again by almost all of the IT industry -- has found the implementation to be quite lacking in many respects. Whereas full unbundling of TO services was originally held out as an ONA objective, substantial bundling in "feature groups" actually remains under TO ONA plans approved by the FCC. That is, to get one feature the enhanced services provider must take others in a package as well. As of this date, there is no known U.S. IT services provider ready to take the new ONA-mandated features under the ONA-specified prices, in many cases necessitating a four-fold increase in monthly rates. In ITAA's assessment, the nonstructural approach as administered by the FCC has provided ineffectual protection from anticompetitive activities by TOs, its disappointing implementation being added to its inherently lesser deterrent strength.

5.2 THE EUROPEAN COMMUNITY (EC)

While U.S. policy proceedings towards greater competition have lasted over the space of two decades or more, the forcing function of the EC's 1992 deadline for its unified internal market has created an urgent need for the EC Commission to struggle with these same issues. As part of its overall 1992 program, the EC Commission has issued six related policy proposals or directives:

- Telecommunications Terminal Equipment;
- Telecommunications Services;
- Associated Competition Guidelines;
- Open Network Provision (ONP);
- Satellite Services; and
- Government Procurement (including telecommunications).

The direction of all these instruments has been to move away from the traditional monopoly approach to the provision of telecommunications services and

equipment, and towards more open and liberal policies instead. ITAA and European users generally have welcomed this new policy direction by the EC.

The EC's approach to competitive safeguards is executed through the application of competition (antitrust) law in conjunction with the harmonization policy, Open Network Provision (ONP). The EC Commission's competition law authority resides primarily in Articles 85 and 86 of the 1957 Treaty of Rome establishing the European Economic Community. The Commission's ONP policy[17] seeks to harmonize, among the Member States, conditions for TO network access by IT services vendors. Member States and subject TOs must adhere to three competitive principles:

- make their decisions by an objective criterion;
- achieve "transparency" by publishing their decisions in an appropriate manner; and
- guarantee equality of access in a nondiscriminatory manner.

These ONP principles are intended to preclude most overt forms of anticompetitive activity by preventing the TOs from discriminating between providers (including their own affiliates) on the tariffs and usage conditions available for various network options. However, the EC Commission has acknowledged that there are situations in which the ONP principles may not protect against anticompetitive activities, such as cross-subsidization of competitive activities by the monopoly parent. For these and other circumstances where ONP does not constitute an effective safeguard, the Commission can apply competition principles directly.

Although competition law is inherently applied on a case-by-case basis, and thus is not enforced through a regulatory structure other than ONP, the EC Commission has published "Guidelines on the Application of EEC Competition Rules in the Telecommunications Sector" (26 July 1991). These guidelines offer advice on the general legal and economic principles followed by the EC Commission in applying competition law to the telecommunications sector. In essence, the EC's competition law (as embodied in Articles 85 and 86) prevents Member States from passing laws, or firms that are considered "dominant" from taking market actions, that fix prices, control markets, or discriminate against market participants. The guidelines describe the application of these principles to the provision of facilities and monopoly services, research and development, TO abuses of dominant position, and mergers and joint ventures.

Although the guidelines are not binding, their application through competition law will be enforced on a case-by-case basis. Thus, a clearer picture will develop of the EC's safeguard regime as harmonized ONP conditions are developed and implemented and competition cases are brought before the Commission.

5.3 JAPAN

The major landmark of modern Japanese telecommunications policy is the 1985 Telecommunications Business Law (TBL). Rather than distinguish between "basic" and "enhanced" services as such, that law chose to distinguish among firms, for legal and regulatory purposes, on the basis of facilities ownership and operation. Thus, the primary carriers such as domestic Nippon Telephone & Telegraph (NTT) and international Kokusai Denshin Denwa (KDD) are classified as Type I; all other firms, including value-added network services providers, as Type II. The Ministry of Posts and Telecommunications (MPT) administers a system of licensing for certifications to offer various services under this classification.

Japanese policy has evolved under a series of International Value-Added Network (IVAN) Agreements, the first of which was reached with the United Kingdom, and subsequent ones with the U.S., Canada, and France. In sum, although terms and conditions vary from one IVAN agreement to another, the agreements represent a significant step toward liberalization in the use of international leased circuits.

The latest step in Japanese policy began in March 1991, in the form of a special issues paper from MPT on "Measures to Ensure Fair and Effective Competitive in the Field of Value-Added Services." MPT stated a belief that, due to its review of Type I carrier charges for value-added services, predation would not be possible. New measures to be implemented are in the Accounting Regulation, effective for the 1992 fiscal year, such that Type I carriers will have to give separate profit-and-loss statements for voice (circuit-switched) and data (packet-switched) traffic, and for any "miscellaneous" service constituting more than 10% of the remainder. Furthermore, MPT promised that NTT would soon be offering its own network services and functions, now supporting its own competitive services, to Type II carriers as well; and that, in the future, such network functionality would be offered to Type II carriers at the same time as to itself. MPT said that the new competition policy would be subject to review within five years.

As to disclosure of technical information, MPT held that, while data for terminal connections had already started in 1990, it was requesting NTT to set up procedures for the dissemination of research and development results. Customer usage information disclosure measures remain the least developed safeguard. MPT announced that NTT had designated its own internally responsible body and established its own rules for in-house use, but there was yet no policy for release to other organizations. KDD has the entire matter under review.

5.4 OTHER COUNTRIES

Other countries have made substantial progress in liberalizing telecommunications services. Thus, they are progressing to the point where public policy discussions about competitive safeguards are meaningful.

5.4.1 CANADA

Canada relies on a mixed system of private and government telephone companies. The Federal Canadian Radio and Telecommunications Commission has adopted express definitions of monopoly "basic" and competitive "enhanced" services similar to, but not exactly the same as, the FCC's definitions in the U.S. The Canada-U.S. Free Trade Agreement was the first international trade document to incorporate trade in services obligations, including nondiscrimination requirements for "telecommunications-network-based

enhanced services." Moreover, Canada recently entered into one of a growing number of bilateral IVAN agreements.

5.4.2 AUSTRALIA

In 1990, the Government announced a package of liberalization measures, contained in legislation passed by Parliament in July 1991. The traditional domestic carrier, Telecom Australia, is to be merged with the international carrier, OTC (formerly Overseas Telecommunications Commission); and a private competitor will be established by year-end with full interconnection rights. The duopoly will last until mid-1997. In addition, the Government is seeking removal of current restrictions on both domestic and international resale, as well as the issuance of three public mobile telephone services licenses.

5.4.3 NEWLY INDUSTRIALIZED COUNTRIES

Hong Kong recently concluded a liberal IVAN agreement with the U.S., providing for essentially unrestricted use of leased lines, without punitive surcharges. **Korea** has been conducting bilateral telecommunications talks with the U.S. for several years. While Korea still maintains the principle that use of leased lines is restricted in general, it has been willing to ease some restrictions in practice and has publicly adopted the principle of network openness. **Singapore** has a telecommunications policy and practice that do not yet match its generally open and progressive overall economic and commercial policies, with national authorities not yet having embraced the concepts behind open network policies or competitive safeguards. **Taiwan** is pursuing an ambitious US$300-billion infrastructure modernization program. Liberalization and competition will become urgent issues as it faces decisions about how to build its telecommunications network for the future.

5.4.4 MEXICO, ARGENTINA, AND NEW ZEALAND

The privatization of previously state-owned telephone companies in these three countries is now making competition questions ripe in there. The North American Free Trade Area talks among the U.S., Mexico, and Canada will include negotiations over access to Mexican basic network services and facilities for U.S and Canadian IT services firms.

6. CONCLUSION

The emergence of competition between TOs and independent computer and information services vendors raises complex questions at the intersection of competition and telecommunications policy. The same ubiquity that allows the TO to provide desired services inevitably creates the ability and incentive for it to take unfair advantage of its less powerful rivals in competitive services. Options for regulatory safeguards, not all mutually exclusive, include an exclusionary rule; structural safeguards (fully separated subsidiary); resale; and nonstructural safeguards (accounting, regulation, information disclosure).

Debate may well center on the merits of structural versus nonstructural safeguards, or a combination of the two, with permissible resale possibly a part of either package. ITAA does not suggest that any one answer may apply to all situations. In light of political, economic, and cultural differences from one country and region to another, a good structure for one country may not be equally suitable for another. The objective in any event should be the promotion of competitive information technology markets through the restraint of TO monopoly power, however that objective is best achieved. in the context of each country's legal and regulatory system. That the International Chamber of Commerce, the world's leading business organization, has devoted so much attention to these issues underscores their importance in world economic growth.

Through the application of effective competitive safeguards, balance must be sought between the dynamism of entrepreneurial innovation, as reflected in competition policy, and the social objectives of diverse and geographically comprehensive services reflected in telecommunications policy and TO operating practices. This paper has sought to illuminate the nature of the choices and to delineate the wide range of informed approaches.

NOTES

1. Estimates by INPUT, Menlo Park, California, USA.

2. Estimate by International Data Corporation, Framingham, Massachusetts, USA.

3. This paper uses TO, in accordance with growing practice, as a neutral international term applying equally to franchised telecommunications enterprises regardless of ownership. The term PTT (post-telegraph-telephone), now in decreasing usage, has denoted government enterprises.

4. "Assurance of Fair Competition by Telecommunications Organizations," Position Papers Nos. 14-16, Paris, November 1990.

5. Resale, to be sure, refers to an action permitted to a user (in this case, an IT services vendor), rather than to one prohibited to the TO, the usual form that a safeguard takes. Inasmuch as resale does stop the TO from earning above-normal profits on its leased lines, and since it would be awkward to separate out resale from associated restrictive safeguards, this paper will speak of it as a safeguard. See Section III.D.

6. This particular case of network information involves the interplay of competitive equity and privacy or data protection issues. Generally, ITAA takes the view that, for data of this sort, a negative check-off or "opt out" option for subscribers suffices for their privacy interests, rather than the more cumbersome positive written consent. However one judges this issue, adequate data protection in no way justifies an asymmetry of access to subscriber data in favor of the TO to the disadvantage of independent IT services vendors. For a fuller discussion, see the related ITAA issue paper, "Personal Privacy and Data Protection."

7. These principles are expressed in accordance with U.S. accounting practices. Accounting rules must be tailored to be consistent with national accounting practices.

8. Terminology varies slightly. In the U.S., one refers to Open Network Architecture; in Europe, to Provision; in Japan, to Doctrine.

9. As a second best solution, if a TO insists on bundling (claiming, for example, that it is technically unavoidable), the the TO must be required 1) to use the bundled package in serving its own customers, and 2) to purchase or impute those service prices to its own competitive services at the same tariffed rates charged to all customers.

10. U.S. v. AT&T, 552 F.Supp. 131 (D.D.C. 1982).

11. RBOC has become the most common term for the seven companies thus created, called Regional Holding Companies by the Modified Final Judgment (MFJ) or Consent Decree, in distinction to the 22 Bell Operating Companies owned by them, who retained their names and service areas under the Decree.

12. See note 16 below.

13. As it does not represent long-distance or equipment companies, ITAA has formally remained silent about those particular restrictions.

14. "A basic transmission service is one that is limited to the common carrier offering of transmission capacity for the movement of information. In offering this capacity, a communications path is provided for the analog or digital transmission of voice, data, video, etc. information. Different types of basic services are offered by carriers depending on a) the bandwidth desired, b) the analog and/or digital capabilities of the transmission medium, c) the fidelity, distortion, or other conditioning parameters of the communications channel to achieve a specified transmission quality, and d) the amount of transmission delay acceptable to the user. Under these criteria a subscriber is afforded the transmission capacity to suit its particular communications needs." Amendment of Section 64.702 of the Federal Communications Commission's Rules and Regulations (Second Computer Inquiry), 77 F.C.C. 2d 384, 418-21 (1980).

15. A common carrier, at least in the common-law tradition, is one, either in transportation or communications, offering an essential public service and thus obligated to serve all customers and to do so equally, and to expand service capacity to meet the quantity demanded at its publicly regulated (sub-monopoly) price.

16. "For the purpose of this subpart, the term 'enhanced service' shall refer to services, offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, code, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different, or restructured information; or involve subscriber interaction with stored information. Enhanced services are not regulated under Title II of the [U.S. Communications] Act [of 1934]." 47 Code of Federal Regulations (CFR) 64.702(a) (1990).

In the Third Computer Inquiry, the FCC had made clear that protocol processing, in particular, is treated as enhanced and not basic: "The term 'enhanced service' shall refer to services offered over common carrier transmission facilities, which employ computer processing applications that act on the format, code, protocol or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different, or restructured information; or involve subscriber interaction with stored information." Amendment to Section 64.702 of the Commission's Rules and Regulations, 2 FCC Rcd 3072, 3074 (1987).

17. Directive of 28 June 1990 on the Establishment of the Internal Market for Telecommunications Services Through the Implementation of Open Network Provisions, 90/387/EEC, Official Journal of the European Communities, L 192, Vol. 33 (24 July 1990).

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Wednesday, January 15, 1992

Plenary

NOTES

TELECOMMUNICATIONS DEVELOPMENT AND TECHNOLOGY TRANSFER IN TAIWAN, ROC

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[Abstract]
Today , DGT is spending about US$ 2.3 billion every year for the network modernization and expansion of network capacity. The goal of building Taiwan as one of the financial centers in West Pacific is both logical and substantial. Through the heavy investment and managed efforts of technology transfer. Our goal will be realized by the end of 1996.

I. INTRODUCTION

Nowadays telecommunication is an integral part of people's daily life. Due to the effectiveness of network construction and operation, telecommunication provides people with speedy and convenient means for communication in both near and far-off distance. Taiwan, the Republic of China, is situated in the geographically strategic area in Asia. Based on our prediction about the future of this region, we deem it very important and practical to build this nation a telecommunication hub by enhancing our network construction.

We have also taken heed to another factor which will influence the future situation of Asia. Many people are quite concerned about the future and unpredictable impacts of Hong Kong after 1997. Aside from the probable political uneasy of the unstable economical prospects, a steady growth of economy and the attractiveness of financial resources must be preserved in this region whether the approaching unpredictable change of Hong Kong will happen or not. Building Taiwan as one of the financial centers in West Pacific to counter-balance the uncertain effects of 1997 is not only logical but substantial.

As we have set our goal and direction for the development of telecommunications, here I would like to focus my topics on the current development and the technology transfer in telecommunications in Taiwan, and taking this opportunity, to introduce our nation's "Six-Year Telecommunications Development Plan" which is designed to fulfill the above purposes.

II. CURRENT TELECOMMUNICATIONS DEVELOPMENT IN TAIWAN

1. Public Switched Telephone Networks

The popularity of telephone services can best represents the telecommunications development in Taiwan. Due to ever fast promotion of living standard and the economic prosperity of Taiwan in the past few years have stimulated significantly the demand for the telecommunications service. In order to cater for customer's demands and raise the network quality at the same time, DGT has not only devoted to modernize its plant facilities, but has also accelerated the digitization and optimization of the infrastructure of entire network. Currently the public switching telephone network is comprised of 3 primary centers, 15 toll centers and 1,032 local switching units. Among them, 92% of toll switching lines and 44% of local switching lines are digitized.

By September 1991, the number of subscribers has grown to 6.7 million and the telephone density has reached 32 main lines per 100 persons. We still remember the hard time of the early 70's, our growth rates were more than 20% annually, we had to double our plant facilities every 3 years. Even today, the growth is about 8.5% every year, is still higher than those countries with telephone density exceeding 30 main lines.

The investment in telecommunications in Taiwan has to rely on a self-supporting financial base and should be able to keep pace with the nation's economic planning and development. Today, DGT is spending about US$ 2 billion every year for the network modernization and the expansion of

network capacity. Special efforts have been made to generating revenues from new services.

2. International Network Development

To keep pace with the development of international trade and the rapid increase of people going abroad, as well as the growing interflow in international economics and culture, the International Telecommunication Administration (ITA), a subordinate organization under the Directorate General of telecommunications (DGT), has been engaged in the diversification, digitization and sophistication of communication satellite systems, optical fiber submarine cable systems, and international telephone and telex systems in recent years to upgrade the quality of international communications.

We have three standard A type satellite earth stations located in Taipei, and one brand-new satellite earth station located in the southern part of Taiwan. As satellite communication is going to digital as a world trend, ITA is gradually utilizing the most advanced communications facilities such as TDMA, IDR and IBS. We will set up two coastal stations to provide international maritime satellite communication services to the vessels sailing in the Pacific and Indian Oceans.

The technology of digital optical fiber submarine cable has come to maturity. Large capacity, long repeater span and high reliability are its major advantages. We have been directly investing in submarines cables through joint venture in Asian and Pacific region during recent years. These include the Asian-Pacific Cable, PACRIM-EAST, PACRIM-WEST, Australia-New Zealand No.2 cable, NO.5 Hawaiian cable, Burnei-Malaysia Cable, Brunei-Singapore Cable, No.4 Trans-Pacific Cable, No.2 Mediterranian Cable, and No. Se-Me-We Cable. At the same time, we have also procured the IRU to increase our traffic carrying capacity in the Atlantic Ocean. We believe that our communication facilities covering these three oceans will have enough capacity to accommodate the steady growing international traffic.

Today, we have a total of 4,709 direct telephone circuits and 752 telegraph, telex and data circuits to connect to 193 countries and regions. The growth rate of international telephone traffic was about 26% last year. In addition to the traditional Telephone and Telex, we also provide new services such as International free phone (I-800). International Operater Direct Connection (IODC), Store and Forward Facsimile.Since May 1989, we have provided the international video conference service to link Japan, USA, Hawaii, Singapore, UK and Hong Kong via IBS satellite circuits.

3. Data Service Networks

Data communication service plays and important role in Taiwan. DGT is responsible for providing public data communication service to the government agencies, private enterprise and the general public for their promotion of business operation, management and decision-making. We also provide the data circuit facilities to support the Value-Added Service providers to run their service. The Value-added Service has been liberalized to the private sector since in 1989 in Taiwan.

There are two packet switched data networks in Taiwan with 3 nodes located in Taipei, Taichung and Kaohsiung respectively. With a total capacity of 3,400 ports, there are 2,777 data subscribers linking by standard CCITT interfaces to the packet switched networks. Though our international gateway, subscribers enjoy the worldwide data-bank access. Taking this advantage, many subscribers set their firms and establish their global information centers in Taiwan. Last year, the growth rate of packet switched data services was 34%.

As computers overwhelmingly become part of our daily life in Taiwan, transfer of information becomes more and more imminent. The demand comes not only from business, but also from residences, not only in quantity, and quality but also in diversification. So the weighing of data communications services is expected to become heavier. To meet the diversified requirements we have established various data networks and provided the following data services:

- Leased data circuit
- Packet switching network
- Circuit switching network
- Chinese Videotex
- Public Information Processing Mail (PIPMAIL)

- Multi-Access Reservation Network (MARNET)
- Teletex
- Local Area Network (LAN)
- Public Information Process Service (PIPS)
- Mobile Vehicle Driver Network (MVDNET)

It is anticipated that the annual growth rate of data communications service in Taiwan will reach 30% in average. The ongoing network development will be focused on high speed processing, mass storage capacity and real-time transmission in order to promote the integration of computer and communications technologies.

4. Mobile Communications Development

Paging services and cellular mobile radio telephone are very popular in Taiwan today. For paging service the growth of paging subscriber is about 36% and the number of paging subscribers has reached 1 million. Both single-tone and display pagers are available in our paging system--the world largest paging system today which covers areas islandwide.

Mobile telephone is another rapid growing service in Taiwan. This service has opened in 1989 to meet with the requirement of the people-in-the-move. The service area covers three metropolitan areas of Taipei, Taichung and Kaohsiung as well as the area along the Chungshan Freeway, and it will be gradually expanded to cover other major cities of Taiwan. With a rocket-high rapid growth rate of 200% in the last year, now we have more than 210,000 subscribers today.

The mobile telephone system utilized in Taiwan today is an Advanced Mobile Phone System (AMPS) of North American standard. The urgent demand from subscriber pushes DGT to expand the system. Our next expansion project is to enlarge the capacity of the system to accommodate another 270,000 subscribers spreading over the whole island.

III. THE 6-YEAR TELECOMMUNICATIONS DEVELOPMENT PLAN

The telecommunications in Taiwan has made great advanced over the past decades. Our country has emerged on the list of fastest growing countries in the world in terms of telecommunications development. This is a mixed result obtained from the far-sighted development policy, the increasing demands of various sectors, the contribution of local telecommunications industry, and the endeavour of our colleagues.

Since 1980, in addition to the conventional voice traffic, the demands for data communication services has been growing rapidly. Such non-voice communication traffic will continue to boom up in the years ahead in parallel with the popularization of computers. To cope with the growth of the information oriented demands.

DGT has mapped out a "6-Year Telecommunications Development Plan" for the period of 1991-1996. In fact, this plan can be treated as a catalyst to transform ROC's telecommunications infrastructure into an intelligent and diversified one.

This plan includes the following 10 major construction projects:

- The construction of 10 million lines of local digital switches.
- Fully digitization of the toll switching systems in 1994.
- Mass construction of optical fiber transmission network.
- The construction of optical fiber transmission backbone along the Chungshan Freeway with a total length of 420 Km.
- The deployment of private circuit network with Digital Access Cross-connect Equipment (DACE).
- The construction of Taiwan-Matsu optical submarine cable to link Taiwan and off-shore island.
- Joint-venture to construct the Asian-Pacific submarine cable.
- The deployment of Personal Communication Network.
- The construction of Intelligent Network for providing services such as Call Card, Advanced Freephone, Mass Calling, Tele-voting and Virtual Private Network.

- The construction of ISDN for an early commercial use.

The total amount of capital investment in the next 6-year is about US$ 14 billion, and after the completion of the project, the digitization ratio of our local switching system will reach 92%, that will be the direct effect with such highly digitized infrastructure, we expect the ISDN service can be commercially interested in 1992 with a sound beginning of 1,000 users and reach 25,000 users in 1996, then gradually to become popular in the turning of next century.

IV. TELECOMMUNICATIONS TECHNOLOGY TRANSFER IN TAIWAN

The industry of telecommunications, as publicly recognized, has some characters, such as team work, intensive research and development, emphasis on maintenance and after sale service, and capital intensive investment. Especially when the advanced technology is a driving force behind the development of telecommunications service, such technology becomes not only costly to yield, but time consuming to reach its practical and commercial availability.

AT the end of 60's, DGT recognized that there existed a technology gap between Taiwan and some telecom leading countries such as USA, Japan and some European countries. In order to establish sound foundation for development of telecommunication technology, DGT set up the Telecommunication Laboratories (TL) in 1969. The mission of TL is to support DGT and its subordinates for the expansion, and improvement and modernization of the communication facilities and operating system so that more economic and high quality services can be provided to the public. By the turning of 80's, the goal of TL has been switched to "pave the way toward ISDN, both narrowband and broadband".

Currently, the resource allocated to TL is about 2% of DGT's revenue every year, which is about US$50 million. This founding is rather enormous, but can only support TL to conduct the R&D for the required technology to keep DGT's business running. It still unable to fill the long existed technology gap. A more effective and more efficient mechanism shall be implemented to save time for developing the leading-edge technologies. This approach is the technology transfer for the reason that transfer of technology has now become a very important business tool in today's fast changing and highly competitive world. In Taiwan, the technology transfer is a two-way approach, which has made notable effects and has reflected its advantages by higher technological level, larger system capacity, and better service quality.

For the technology transfer from overseas to Taiwan, 98 DGT employees were sent abroad to participate in the international conferences,symposiums and workshops in the past two years. At the same time, over 140 scholars were invited to come over to Taiwan and gave lectures of in different fields. To expedite the result of R&D, some licensed technologies and software were procured from foreign leading research institutes and companies. About 50 kinds of technical books, journals are also subscribed by TL to keep track of the most advanced development of telecommunications technology. In addition, joint venture of DGT with the three telecom manufacturing companies are still under way. These companies are AT&T Taiwan Telecommunications Inc., Taiwan International Standard Electronics Ltd. (TAISEL), and TAICOM System Limited. Through the joint venture, the advanced digital switching systems, such as AT&T's 5ESS, Alcatel's System 12, and Siemens EWSD (Taicom-5) have been manufactured in Taiwan with high percentage of local integration. Every year DGT procures from these manufacturers about 2 million lines of their switching system.

Moreover, a Science-Based Industrial Park was established in Hsin-Chiu, located in the northern part of Taiwan, in 1979 by government to encourage the return of overseas Chinese scholars and engineers to help set up high-tech firms in the Park. There are now 135 companies in the Park and 23 are engaged in the telecommunications-related activities.

As to the technology transfer from domestic R&D institutes to domestic industry, during the past decade from 1980 to 1990, DGT transferred many research results to the local manufacturers. The technologies have been successfully transferred to Taiwan's local manufacturers through 104 different contracts. Some of

the products have been put into service by DGT or exporting to overseas.

DGT has also enhanced the technology transfer through the mechanism of technology cooperation with local manufactures in the areas of System-12 Centralized OA&M System, Mini VSAT Network Operation and Management System, SONET Broadband ADD-Drop Multiplexer (ADM-600), Development of Optical AM Laser Link, Multi-channel FM-PSK Video Optical Fiber Transmission System, and ISDN PABX.

At present, DGT integrates the efforts of technology transfer and technical cooperation with local manufacturers and research institutes on the main topics of "ISDN CPE" and "broadband ISDN". This approach is aiming at the enormous market needs locally and abroad when ISDN and B-ISDN are going to be pervasively deployed in the coming years because the world trend are so obvious. Through the effective integration of the R&D resources, we will keep track of the world's technological development and winning our leading position in telecom hi-tech.

V. CONCLUSION

In the early 50's, only a small number of people in Taiwan were able to afford the telephone service. Today, you can find that about 92 residential households out of 100 have telephones to connect with all other telephones in every corner of Taiwan. We have witnessed the evolution that telecommunications have been contributed to creating the "economic miracle" in Taiwan. We still remember the "art" of how to make the best expansion of our telecommunications infrastructure with very scarce resources to benefit most to the national economic development. From this experience, we have the confidence that we can update our telecommunications to benefit the regional economic prosperity in Asian Pacific by the following ways:

- To increase the network capacity to meet the short-term and long-term requirements.
- To assure the network reliability to prevent the disaster due to communication interrupts.
- To reduce the network pricing to attract more users.
- To heavily invest on telecommunications construction projects to promote the prosperity of telecom/information industry.
- To provide swift telecommunication channels to assure better understaning of the governments and the people among the countries of Asian-Pacific.
- To market our dedicated services to fit those specific, and major customers.

The picture keeps in our mind is quite clear--- through heavy investment in telecommunications, many endless economic loops which bring countless wealth, will thus be generated in the way very similar to the nuclear chain-reaction. When the top priority was allocated to the telecommunications, and about 1.5% of GNP has been allocating to network construction, the great benefits to economic prosperity as well as leveling up the people living standards are predictable. It is hoped that our past experiences in telecommunications development, through the horizontal development of networks, and then to the vertical enhancement of services, which have been proved successfully in many occasions, will be applied today and tomorrow to make Taiwan a real contributing party of telecommunications hub in this region. We would like to have opportunities to share our experience with you !

Liberalization, Government Commitment And Telecommunication Performance: A Study of Telecommunication Sector Restructuring In Developing Countries

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1. ABSTRACT

This paper presents the results of an empirical study of the impact of policy liberalization and increases in government commitment on the growth of telecommunications in 81 developing countries. The relative impact of these two trends is evaluated in terms of sector performance and distribution of basic telephone services.

2. INTRODUCTION

Telecommunications are increasingly being recognized as critical strategic infrastructure for ensuring the success of national social and economic development plans and programs, improving international competitiveness and integrating domestic economies into the world economy. New attitudes toward the economics of telecommunications and the role they play in overall growth and development are gradually being translated into stepped-up investments in the sector in many developing countries. In an effort to improve sector growth and development and overcome chronic deficiencies in telecommunication performance and distribution, many developing countries are engaged in revamping their sector policies.

However, there appears to be little consensus on the policies, regulatory mechanisms and sectoral arrangements which further the effective development of the sector. There are virtually no cross-national empirical studies of the impact of policies on the growth and development of the sector and few country specific studies of these issues. Despite this lack of research on the possible consequences of telecommunication policies on sector growth, many developing countries have been engaged in the process of sector restructuring. These changes have almost unexceptionably been directed at liberalizing the sector, where liberalization refers to the movement toward privatization and the introduction of competition.

This paper is motivated by the argument that sector policy changes may have significant consequences for telecommunications development. That the movement toward liberalized structures may not necessarily improve sector performance but may, on the other hand, adversely effect the conditions of access to and availability of telecommunications in many countries. This paper presents the results of a longitudinal cross-national study evaluating the impact of telecommunication policies in 81 developing countries on both the performance of their telecommunication sectors as well the distribution of services.

3. THEORETICAL DISCUSSION

The world telecommunications scenario has undergone dramatic changes in recent years. New information and communication technologies have transformed global and local economic activities. No country is exempt from the influence of this revolution. Reacting to these developments, governments, legislatures and regulatory bodies in most countries are engaged in re-evaluating the policies that govern the ownership and supply of telecommunication equipment, facilities and services with the aim of introducing private competition.

This drive toward liberalization is a marked departure from the policy framework which has governed the telecommunications sector in developing countries for a number of years. In the past, telecommunications was considered a good example of a natural monopoly, "an essential public good that governments should provide in a non-commercial mode" (Nulty, 1989, p. 7). Consequently, telecommunication services were provided by public enterprises under monopoly conditions. Changes in the technology and economics of telecommunications, it is argued, have eroded the condition of natural monopoly and the state monopoly structure is now increasingly being held responsible for the inadequate growth of the telecommunications sector in the past, and for its potential to hinder expansion and growth in the future.

The theoretical underpinnings of this drive toward liberalizing telecommunication policies are based on the many virtues of the market mechanism that have been detailed in neoclassical economics and which are being more or less vigorously embraced by a number of countries. Open competition and the relatively

unhindered operation of market forces, it is argued, will result in stepped-up sector growth and improved sector performance and efficiency (Saunders, Warford and Wellenius, 1983).

In short, the drive toward liberalization is based on the assumption that private competition may be the most appropriate mechanism for ensuring the growth and development of telecommunications. However, this belief in the ability of markets to foster the growth of telecommunications in developing countries, is not without its critics.

Raul Katz (1988) in his study of the information sectors in developing countries, argues that -- in contrast to developed countries where the development of telecommunications is the result of economic forces -- it is politics, rather than markets, that drives the growth of telecommunications in developing countries. There are two main reasons for this, the first concerned with sector efficiency, the second with sector equity.

First, despite the existence of some elements of competition, telecommunication markets in developing countries are far from efficient. Whether or not the sector is a natural monopoly, there do exist significant economies of scale which tend to be lost with the break-up of the public network. Additionally, the efficient operation of the market depends upon effective competition which is often difficult to achieve when economies of scale are large.

Second, markets usually deal inadequately with the provision of public goods or services like telecommunications. The market system works by putting a price on a service and the allocation of that service between consumers is made by their willingness to pay that price. When prices reach equilibrium it is assumed that demand for the service matches supply. This reliance on willingness to pay has obvious consequences for equity since, as Sen (1990) points out, "the willingness to pay also depends on the *ability* to pay" (p. 19; emphasis in original). Hence, even under conditions where competition can lead to improved sector performance and efficiency, it could very well lead to adverse conditions of distribution and equity.

Because of these dual shortcomings of the operation of market forces, particularly with respect to developing countries, Katz (1988) argues that "the expansion of the telecommunications infrastructure in most countries is a decision that pertains to political authorities" (p. 58). And the most effective instrument of governmental commitment to sector growth is the amount of resources it allocates to telecommunications. Pool (1963) argues that different investment practices may lead to the development of very different communication systems and, therefore, a major issue for most developing countries is how much of their resources to invest in communications.

Thus we see that in seeking to find ways to further the growth of telecommunications in developing countries we are faced with a number of competing approaches. On the one hand, there are those who argue that policy liberalization, characterized by the movement toward the introduction of private competition -- i.e., the operation of market forces -- may be the best solution for the problems of future sector growth and expansion. On the other hand, governmental control and commitment to sector growth, reflected in increased government investment in telecommunications -- i.e., the operation of political forces -- is also posited as an appropriate mechanism for telecommunications growth in developing countries.

At the same time telecommunication policies need to reconcile the possibly conflicting objectives of performance and efficiency with those of distribution and equity. This is an important issue since misplaced sector goals may run contrary to overall development strategies and objectives. In terms of both theoretical perspectives on the development process and empirical evidence of the role of telecommunications in that process, there is growing recognition of the need for balanced and equitable growth of the sector in developing countries.

Theoretically, the movement of thought in the disciplines of development economics and development communications has been toward underlining the importance of the distributional outcomes of development. The development economist Amartya Sen (1983; 1984) argues that the goal of development should be to enhance the capabilities of all individuals. Similarly in development communications, Kincaid's network-convergence theory (1988) and Krippendorff's theory of autopoetic development (1988) establish the importance of equitable access and availability of telecommunications to all individuals, communities and regions.as crucial to expanding their own potential as well as the potential of the societies in which they live.

Empirically, the importance of making telecommunications available to all sections of society is being increasingly documented. This ranges from case-studies of the introduction of telecommunications in different communities and their application in various sectors (Saunders, et. al.,1983; Hudson, 1981, 1984; Goldschmidt, et. al. 1982); through cost-benefit analyses of telecommunication projects to determine the rate of return on investments achieved by these projects (Kamal, 1981; Kaul, 1981; Saunders, et. al., 1983; Chu, et. al., 1985); to input-output analysis of the sectoral benefits of telecommunications (ITU, 1965, 1976; Lonnstrom, et. al., 1975; Kaul, 1979).

In short, it is apparent that regional, economic and social entities can play an important role in the development process, as long as they are provided the means and resources to fully participate in the lives of their nations. The role of governments, and by extension of the

policies governments formulate to govern various sectors like telecommunications, must be, therefore, to ensure that the conditions necessary for such participation are available and that no regional, economic or social entity is systematically deprived of access to those resources.

The preceding theoretical discussion suggests the following research questions which need to be addressed in an empirical study evaluating the impact of different telecommunication policies on sector performance and distribution:

1. What are the types of telecommunication policies existing in developing countries? How have these policies changed over the past decade?

2. What has been the pattern of government commitment to telecommunication sector development?

3. What are the patterns of telecommunication performance and distribution in developing countries?

4. Is there a relationship between policies and performance and policies and distribution?

5. Is there a relationship between commitment and performance and commitment and distribution?

6. Do these relationships hold after accounting for the level of economic development?

4. METHODOLOGY

4.1 Sample & Data

A total of 81 developing countries were selected for analysis after eliminating those with completely centrally planned economies and populations under 1 million in 1977. The study involved the analysis of secondary data which was collected from a number of different sources including the ITU's *Yearbook of Common Carrier Statistics*, AT&T's *World Telephones* and country reports maintained by the CCITT and the World Bank. The period under review was 1977 to 1988. More specifically, the impact of changes in policies and government commitment from 1977 to 1987 were examined in relation to changes in telecommunication performance and distribution from 1977 to 1988.

4.2 Variables

The research questions posed in the preceding section suggest four sets of variables involved in the study. The first set, the dependent variables, relate to telecommunications outcomes. The second, third and fourth sets, the independent variables, relate to telecommunication policies, government commitment and the economic factors that are thought to condition the relationship between policies and outcomes.

4.2.1 Telecom Outcome Variables

Telecommunication outcome variables (relevant to this study) are of two kinds: 1) variables measuring commercial performance and national level indicators, together referred to as *performance variables*; 2) variables measuring the conditions of availability and access to services, together referred to as *distributional variables*.

Performance Variables: The four main areas selected to represent improvements in telecommunication performance were: 1) expansion of basic telephone service, measured as the number of telephone lines per 100 persons; 2) improvement in network efficiency, measured as the average number of telephone calls completed per line per year; 3) demand performance, measured as the reduction of outstanding demand for basic telephone service; 4) improved financial performance, measured as increases in annual sector profits.

Distributional Variables: The two main areas for measuring availability and access were: 1) regional distribution, i.e, differences in the availability of, and access to, services between rural and urban areas and measured as the number of telephone lines per 100 persons in rural and urban areas; 2) the affordability of basic residential service, measured as the national average price of such service after converting to cross-nationally comparable international dollars (*World Tables, 1990*).

4.2.2 Telecom Policy Variables

The three main areas in which telecommunication policies were examined were: 1) policies governing the manufacture and procurement of telecommunications equipment; 2) policies governing the ownership of telecommunication facilities; 3) policies governing the supply of telecommunication services. The measurement of these variables involved the coding of policies, regulations and rules governing the extent of privatization and competition in each of these areas. Each variable was measured as the extent of competition and privatization permissible in each of the three areas on a ten point scale with 1 representing state owned and controlled monopolies and 10 representing private ownership and open competition, both domestic and foreign.

4.2.3 Government Commitment Variable

Government commitment to the growth of telecommunications was measured as the total annual government investment in telecommunications in each country, as a proportion of total annual government investment.

4.2.4 Economic Variables

The level of economic development is considered an important determinant of the growth of telecommunications. Per capita GNP is the most commonly used indicator of economic development in both economic and telecommunication studies and is used in this study as a control variable. GNP figures used here are those reported by the World Bank (*World Development Report, 1990*).

4.2.5 Research Design

The empirical analysis performed in this study was in three parts. First, *descriptive*, showing the state of the telecommunications sector in terms of policies, outcomes (performance and distribution) and commitment in 1977 and 1988. In the case of policies simple comparisons between measures at these two points in time would not be very useful in evaluating what is essentially a dynamic phenomenon. Therefore, using measures in 1977 and 1987 a policy change variable was constructed for each of the three policy areas -- equipment, facilities and services -- measuring both the recency and magnitude of policy changes through the following formula: $C = (M * T)/10$; where: C = average annual rate of change; M = extent of change from 1977 to 1987; T = number of years policy has been in place. The policy change variables were used in the analyses.

Growth rates were also calculated for government commitment and GNP/capita, in addition to comparing the state of the variables in 1977 and 1987. Here again growth rate variables rather than the single-point-in-time measures were used in the analyses.

The second, was *correlational*, showing the relationships between policies and performance and policies and distribution. The correlational analysis was designed to reveal whether or not changes in policies are significantly associated with changes in tele-communication outcomes. This analysis was further detailed by comparing the relationships between policies and performance and policies and distribution at different levels of national income: low, middle and high. Low income countries were defined as countries with with per capita incomes of less than $500. Middle income countries were those with GNP/capita between $500 and $5,000 and high income countries with GNP/capita over $5,000.

The third set of analyses were *multivariate*, estimating parameters of a regression model including both policy and economic variables. The regression model used in the study is a variation of the panel design. To capture the dynamic nature of policy developments as well as the impact of changes in economic variables, growth rates of policies, government commitment and GNP/capita (from 1977 to 1988) were used instead of static variables measured in 1977.

The final model was in the following form:

$$Y_t = a + b_1 Y_{t-1} + b_2 X_{ri} \ldots + b_n X_{rn} + e.$$

Where:

Y_t = dependent variable at time t

Y_{t-1} = lagged dependent variable

a = constant

b = unstandardized regression coefficient

$X_r i..X_{rn}$ = growth rates of independent variables

e = error term.

5. FINDINGS

Telecommunication sectors have undergone considerable changes during the eleven years spanned by this study. Despite financial and technical bottlenecks and rapid population increases, developing countries, as a whole, have shown improvements in most telecommunication outcome indicators. Table I compares summary statistics for telecommunication outcome variables (both performance and distribution) for 1977 and 1988.

Line densities (LinDen) have increased significantly over the period and traffic densities (TraDen) have also gone up. What is perhaps surprising is that demand performance (DemPer) has improved over the period with the registered demand for lines expressed as a proportion of existing number of lines being reduced by about ten percent. What is not surprising is that financial performance (FinPer) has worsened over the period. Whereas in 1977 profits were on average about 35% of expenditures, by 1988 they were registering an average loss of about 8%. Clearly, what was once a relatively profitable sector is increasingly becoming a financial burden in a number of countries (Nulty, 1989).

In keeping with the increased national level line densities, both urban (UrbDen) and rural (RurDen) line densities have shown improvements from 1977 to 1988. What is worrying is the significant increase in the average price (AvgPri) of basic residential service. The 1977 figure of about three international dollars per year represented from 8 to 12 percent of the average annual income of most people in developing countries, while the 1988 figure of almost five international dollars amounts to between 15 and 18 percent of average annual income. It appears that basic telephone service may be increasingly unaffordable in many countries.

Perhaps the most important assumption on which this study is based is that there have been significant changes in telecommunication sector policies, specifically those relating to equipment, facilities and services, over the period under study. These changes have been characterized as a process of liberalization encompassing the two axes of increased competition and movement toward privatization. In addition, there is also the presumption that

government commitment to the sector has also been stepped-up in many countries. Table II presents summary statistics for the three policy scales in 1977 and 1987 as well as the government commitment variable.

Clearly, policies relating to all three areas, equipment (EqPol), facilities (FacPol) and services (SerPol), have undergone liberalization over the period. Policies relating to the manufacture and procurement of telecommunications equipment were the most liberalized, even in 1977, and remained so in 1987. Service sector policies show a clear trend toward liberalization and there has also been movement toward liberalization in the facilities area. At the same time, government commitment to the the growth of the sector (Invest), measured as governmental investment in telecommunications as a proportion of total government investment, has also registered dramatic increases. There was an an almost five percentage point increase in investments in telecommunications from 1977 to 1988 providing clear evidence of the growing importance of the sector for developing countries.

While it is clear that telecommunication performance and distribution, as well as policies have undergone considerable changes over the period under review, are these changes related? The initial bivariate analysis of the relationship between policy change and performance suggested that policy liberalization is significantly related only to improvements in national line densities, while increases in government commitment are significantly related to improvements in line densities as well higher traffic densities and better demand performance

When these bivariate relationships were specified by levels of national income, the relationship between government commitment and performance remained consistent at all three levels of national income, low, middle and high. In contrast, the relationship between liberalization in the three policy areas and improved performance was significant only for high income countries.

Multivariate analysis further minimizes the impact of liberalization on performance. Table III provides the standardized coefficients of the regression of each of the four performance variables on the independent variables.

We note that there are virtually no significant coefficients for the three policy variables for any of the performance variables. In other words, after we account for the effect of the growth of GNP and the growth of government commitment, there are no significant independent effects of any of the liberalization variables. In contrast the government commitment variable maintains a significant independent impact on three of the four performance variables, underscoring the importance of the state for the growth of telecommunications in developing countries.

A similar step-by-step analysis was conducted for the distribution variables. The bivariate analysis revealed that liberalization of facilities, services and equipment policies are highly correlated with worsening conditions of access to and availability of telecommunication services. This is particularly true of the relationship between liberalization and increases in the price of basic residential service. In terms of the urban-rural divide, rural densities are negatively related to the three liberalization variables while urban densities are positively related to liberalization. In contrast, increased government investment in the sector appears to improve both rural and urban densities and is not related to increases in average price.

Specifying the bivariate relationships in terms of national income revealed that the deleterious effect of liberalization on rural densities and price of service is particularly acute for low income countries, while the positive impact of government investments is felt uniformly at all income levels.

The regression analysis confirms these trends (Table IV). The improvements in distributional outcomes from increased government investments hold even after controlling for the growth of national income and policy liberalization. Similarly, increases in price are almost entirely accounted for by liberalization in the three policy areas. The relationship between liberalization and poor growth of the rural network also remains significant after controlling for the growth of GNP/capita and government commitment.

6. DISCUSSION

The transformation of the telecommunications sector in developing countries, away from one characterized by state owned, controlled or operated enterprises, is significant. It appears that many developing countries are looking toward domestic and foreign private competition as the panacea for the many ailments of the sector. Perhaps the most remarkable development has been the liberalization of telecommunication facilities though changes in this area have more moderate and slower in coming than changes in the services and equipment sub-sectors. At the same time government commitment has increased significantly over the period under study, reflecting the changing perception that governments and international development agencies have of the importance of telecommunications for national development.

Of these two trends, one toward increased liberalization and the other toward stepped-up government investment, the latter is clearly a more important predictor of overall improvements in telecommunications performance. Increasing levels of government investment are particularly important for telecommunication expansion because of the relatively high capital requirements (Chapius, 1975) and high capital-output ratios (Huntly, 1967) that characterize the

sector. Traditionally, sectors with such characteristics, for example power, have tended to attract private investment mainly in distribution or re-distribution activities and rarely in infrastructural activities. This accentuates the saliency of government investment for sector growth.

Unlike liberalization of policies, increases in the proportion of government investment in the sector is associated with higher line densities at all levels of national income. Clearly, if developing countries are seeking to rapidly expand basic services, then the solution appears to lie more in stepping-up government investment in telecommunications, than in the neoclassical panacea of privatization and the operation of market forces. Indeed, governmental commitment remains an important predictor of network expansion even after accounting for the growth of GNP/capita.

With respect to distribution, again higher rates of growth of government investment are associated with improvements in access to availability of services in both rural and urban areas. In contrast, liberalization clearly leads to a worsening of distributional outcomes, particularly in terms of increases in the price of basic service and the retardation of the growth of the rural network.

Liberalization can lead to higher prices for basic service in three main ways. First, through the movement toward setting prices as close to cost as possible that is usually part of the liberalization process. This tends to eliminate the subsidies that are commonly in place for basic residential service and consequently tends to push up prices. Second, in a number of countries where sector policy liberalization involves the separation of urban and rural services, enterprises are able to take advantage of the outstanding demand for telephone service in urban areas by raising prices. Finally, as Saunders, et. al. (1983) point out, there could also be hidden costs incurred in sector liberalization in developing countries including inefficiencies associated with the loss of economies of scale through network fragmentation. It is quite probable that part of these costs are passed onto consumers.

Of equal concern is the opposite direction of the relationships between liberalization and rural and urban densities. There are three main ways in which sector liberalization can translate into improvements in network expansion in urban areas at the cost of rural areas. First, through the break-up of national monopolies into regional monopolies within the public sector. This enables those regional entities servicing urban areas to concentrate on network expansion and the reduction of outstanding demand without having to worry about transferring financial or technical resources to the more difficult to expand in rural areas.

Second, liberalized sectors are more sensitive to demand than traditional public sector monopolies. Though there is a large unmet demand for telephone service in many developing countries, this unmet demand is concentrated almost entirely in urban areas. Moreover, the demand for service is much more price inelastic in rural areas than in urban areas. Therefore, following these market signals, liberalized sectors tend to concentrate on expanding urban facilities to the neglect of rural areas. Third, it is probable that many services in rural areas may fail to attract private capital or suppliers. Liberalized sectors may be reluctant to invest in rural areas because sunk costs are high and returns low. Thus Walsham (1979) suggests that the expansion of rural service is dependent on either direct government subsidies of financing from out of the financial surpluses generated from urban subscribers and long distance services.

Developing countries, it seems, need to be particularly concerned about the impact of liberalization especially if keeping prices down and increasing rural penetration are national priorities. In contrast, increasing government investment may lead to the expansion of the basic network in both rural and urban areas, without prohibitive increases in the price of these services.

7. CONCLUSIONS

Dallas Smythe once wrote "Governments always, everywhere, intervene in the actions of their populations. The immediately relevant question lies in the answers their policies and actions give to the question: for whose benefit are they intervening?" (1986, p. 21). The findings of this study suggest that the liberalization of telecommunication policies in developing countries leads to a systematic worsening of conditions of access to and availability of basic telephone service with little corresponding gains in improved sector performance. If there are gains to be had from sector restructuring they may be realizable only under conditions of relatively high economic development and in countries with predominantly industrial economies. Perhaps more importantly, this study found considerable evidence that government commitment to stepping up the growth of the sector is the most important single factor in improving both performance and distribution at all levels of development.

There is, therefore, clear indication that if sector growth and development are important priorities for governments than attention should be turned toward stepping-up investments rather than sector restructuring. If sector liberalization is to be considered, then perhaps it would be effective only after certain levels of development have been achieved.

These findings are in keeping with an emerging body of literature which suggests that equitable development of many sectors in the developing world, including health and education, has been fostered mainly through the commitment of governments to sector growth and expansion. Many

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countries that have relied on the market mechanism to foster growth have performed indifferently with respect to growth and worse still in terms of equitable growth (Sen, 1990).

Part of this problem arises from the fact that in developing countries, the market mechanism is inadequate for generating and equitably distributing a number of goods and services, particularly those that economists describe as public goods. Telecommunications, characterized by significant network externaliti, is, in many ways, a quintessential public good. Subjecting it to imperfect markets could prevent any possibility of equitable access to telecommunications in the majority of developing countries.

This study has attempted to evaluate the impact of telecommunication policies with an emphasis on the process of privatization and the introduction of competition that is underway in a number of developing countries. While much of the research attention has been focussed on the changes in the telecommunications sector in developed countries, this study has shown that a slow, quiet, but significant revolution in telecommunications policies is taking place in much of the developing world.

Virtually all reforms being considered by governments involve reduction in the monopoly control of the traditional telecommunications entity and some increase in the influence of market forces over operations and investments in the sector. The reasons behind these changes are manifold. It is believed that liberalization can overcome chronic deficiencies in investments in the sector, cope with the unmet demand for basic services, meet the needs of large users and expand the reach of the basic network. In short, liberalization is perceived to be the panacea for the many performance ills that plague the telecommunications sector in developing countries.

But, as the findings of this study show, liberalization of telecommunications has not been associated with significant improvements in telecommunications performance in the decade under review. As the global economy becomes increasingly integrated developing countries are looking increasingly for new ways to effectively participate in the global electronic marketplace. Telecommunications are now seen as electronic commodities essential to the expansion of national economies (Aronson and Cowhey, 1988). If this perception of the vital importance of telecommunications is to be translated into significant sector improvements, then liberalization may not be the solution. Instead, as already discussed, increased government investment may be the most effective means for significantly improving sector performance.

Efforts to improve sector performance through liberalization can also often lead to difficulties in striking a balance between considerations of commercial efficiency and social equity. Nulty and Schneidewind (1989) argue that in order to respond to growing technical and economic pressures, governments: "give their telecommunication systems greater autonomy and commercial orientation. But important national, social and economic interests will be jeopardized by the move to more commercial modes of providing telecommunications services" (p. 30).

In the traditional organization of telecommunications systems, these contradictions were reconciled directly within the single political body that both operated the telecommunications system and made social, national and economic policy: the government. But in the separation of telecommunications from government control and in the absence of effective regulatory bodies, the mechanisms through which the balance between equity and efficiency were maintained are sundered.

States thus play a two-fold role in the development of telecommunications in developing countries. On the one hand they are the prime sources of finances for investment in telecommunications. The extent of governmental commitment to the sector is the main predictor of the extent of sector expansion. In the second instance, governments provide the only existing effective domain within which competing interests can be reconciled and goals of balanced sector growth and equitable access and availability of services can be maintained.

While the focus of policy reform has been on improving commercial efficiency and sector performance, it must not be forgotten that telecommunications are important public goods with powerful consequences for the process of development. Distributional consequences are, therefore, an important component of policy evaluation. The negative impact of policy liberalization on the conditions of access to, and availability of services, could have grave consequences for national development plans and programs. Inability to access or afford services may result in the systematic deprivation of the potential to increase their capabilities (and, consequently, the conditions of their lives) for large sections of the populations of developing countries.

It is hoped that this study will provide evidence that will help in the evaluation of the telecommunication policies that developing countries have pursued in the recent past -- the impact of liberalization and government commitment on performance and distribution. And, on the basis of this evaluation provide guidance to policy-makers in these countries in selecting between the options available to them for reforming their telecommunication sectors and doing so in the context of their national economies and overall developmental objectives.

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TABLE I

Summary Statistics of Telecommunication
Outcome Variables 1977 and 1988

Variable	Mean	S.D.	Min	Max	N
LinDen77	2.44	2.12	0.57	21.02	65
LinDen88	4.07	2.89	0.82	32.36	67
TraDen77	2,122	1,017	107	6,138	65
TraDen88	3,145	1,417	143	10,319	67
DemPer77	51.98	23.41	0.68	329.66	63
DemPer88	42.10	19.21	0.31	243.69	67
FinPer77	34.51	89.17	-30.72	94.35	65
FinPer88	-8.96	37.49	-173.80	83.55	65
UrbDen77	4.51	2.01	1.87	35.92	61
UrbDen88	6.12	3.56	1.89	46.98	67
RurDen77	1.43	1.56	0.18	18.42	61
RurDen88	3.05	2.78	0.20	29.47	67
AvgPri77	3.12*		1.50	17.18	61
AvgPri88	4.98*		1.51	21.45	61

Notes: For measurement of variables see text; Average Price (AvgPrice) figures are in constant International Dollars; * = Median

TABLE II

Summary Statistics of Telecommunication
Policy and Commitment Variables 1977 and 1987

Variable	Mean	S.D.	Min	Max	N
EqPol77	2.65	1.01	1.00	8.00	65
EqPol87	4.44	2.15	1.00	10.00	78
FacPol77	1.80	1.27	1.00	7.00	65
FacPol87	3.74	2.89	1.00	9.00	78
SerPol77	1.94	1.17	1.00	7.00	65
SerPol87	4.01	2.12	1.00	10.00	78
Invest77	2.66	1.11	1.12	7.89	65
Invest87	7.30	2.17	1.56	13.12	65

Notes: For measurement of variables see text

TABLE III

Regression Estimates of the Effects of Economic and Policy Variables on Telecommunication Performance

	Gnp	EqPol	SerPol	FacPol	Invest	R^2
LinDen	.64**	.13	.11	.16	.29*	.82**
TraDen	.16	.01	.07	.06	.11	.21
DemPer	-.11	-.14	-.17*	-.21*	-.23*	.47*
FinPer	.10	.18	.12	.11	.17	.12

Notes: standardized regression coefficients; variables express growth rates; N = 61; sig. * = .05 ** = .01

TABLE IV

Regression Estimates of the Effects of Economic and Policy Variables on Telecommunication Distribution

	Gnp	EqPol	SerPol	FacPol	Invest	R^2
UrbDen	.52**	.07	.09	.12	.23*	.77**
RurDen	.56**	-.11	-.17	-.26*	.21*	.29*
AvgPri	.16	.21*	.24*	.28*	.09	.65**

Notes: standardized regression coefficients; variables express growth rates; N = 61; sig. * = .05 ** = .01

COMPETITION : A PATH TO NATIONAL AND REGIONAL COOPERATION

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ABSTRACT

As much of the world moves into a new age of competition, Australia, too is undertaking a major restructuring of its telecommunications framework. The Government is instituting fundamental micro-economic reforms across the board, and introducing competition to what had been a public sector monopoly telecommunications provider. This paper addresses the nature and timing of these changes, looks at the processes and the players, and assesses some of the emerging outcomes.

1.0 THE CHANGING ENVIRONMENT

1.1 Globalisation

The world has continued to change markedly since Marshall McLuhan coined *the global village*. Easy access to reliable and affordable communications has not only shrunk much of the world but it has also given rise to typical village markets and competitive business practices. For some years now we have seen increasing internationalisation of businesses as well as changes in the nature of business. The huge demand for a wide range of communications products and services has given impetus to the development of new and exciting technologies and applications.

While this has yielded tremendous benefits to users and to manufacturers, it has also meant that the commercial life of technologies and applications has been considerably reduced. As a result, development has become a high risk/high cost activity, and the telecommunications equipment market has been increasingly dominated by a relatively small number of large global suppliers.

We have also seen standards take on new and critical meaning. Because of the rapid changes in technology and applications, the traditional standard-setting processes of the International Telecommunication Union (ITU) through the CCITT and the CCIR have found it difficult to respond to the pressures of the market place within a commercial timeframe.

As a result, *de facto* standards have emerged because of early market dominance and wide user acceptance. However, the increasing implementation of open systems has helped to unlock proprietary markets and created new opportunities for the smaller players and the specialist firm serving a particular section of the market.

While these outcomes may have introduced the character of a global village - complete with bazaar - they have also confirmed the dominance of export markets by the majors. On the other hand, because of the diversity of user needs within any particular market, the majors are beginning to recognise the valuable role that can be played by competent smaller firms in providing systems adaptation and integration to meet

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the unique needs of the local market and to provide personalised customer service.

Globalisation of telecommunications, therefore, has brought with it a most interesting mix of competition and mutual dependence. The intriguing aspect of these changes is that few firms seem to have recognised that they have occurred.

1.2 The Australian Situation

For a country the same size as the United States with a population less than half that of California, given our geographic location and history it should be no surprise that the Australian situation is unique. Australia has a high standard of living, is a competent user of high technology and has a world class telecommunications network - which is as much due to necessity as to choice.

Providing reliable telecommunications services throughout this harsh continent to all Australians at an affordable cost is a tremendous challenge. The public switched telephone network is an essential asset to people living in remote homesteads and outback mining communities. It also provides a communications lifeline in times of natural disasters, such as during our frequent bushfires and floods, and tragedies such as Cyclone Tracy.

Internationalisation of business has also meant the internationalisation of competition and as pressures mount, so does the demand for a range of quality services and personalised customer support, at lower and lower prices. The same national PSTN that serves an essential community need, must also be responsive to the needs of business and provide world class access to the markets of the world.

There has been a popular perception that because it is a public sector monopoly, Telecom Australia could not deliver the lower prices and innovative new technologies required by business. Others believed that it was unresponsive to customer needs and was relatively inefficient on a world scale, being controlled by a powerful union protective of jobs. Telecom used to employ about 86,000 people.

In the May 1988 Economic Statement the Government announced a new framework for telecommunications in Australia. It also embarked upon a bold program of micro-economic reform across its transport, maritime and aviation sectors. It made sweeping changes to the Telecommunications Act, created a separate regulatory body (Austel) and foreshadowed further liberalisation of the telecommunications environment. With the rapid and severe deterioration of the world economy, however, the Government was again faced with decisions on the telecommunications sector.

1.3 Government Decisions

The Government believed that new attitudes were required in the industry, to be under-pinned by vigorous competition, if Australia was to survive and prosper in the international telecommunications market. On 8 November 1990 it announced a number of decisions which significantly extended the impact of its micro-economic reforms.

The key decisions announced by the Minister for Transport and Communications, the Hon Kim Beazley MP, provided for the following initiatives:

- the establishment by the end of 1991 of a private sector competitor to a merged Telecom/OTC;

- the introduction, as soon as practicable during 1991, of full resale of domestic and international telecommunications capacity;

- the issuing of three public mobile telephone service (PMTS) licences including one to AUSSAT prior to its sale and one to Telecom/OTC;

- the introduction of full competition in the provision of public access cordless telephone services (PACTS);

- consideration of further PMTS licences in 1995;

- carrier competition to be limited to the duopoly until 30 June 1997.

In a subsequent speech on 4 March 1991 the Minister noted that in promoting competition and dynamism in the telecommunications industry, the Government wanted to position Australia to take advantage of new export and job opportunities that will be created around the world, particularly in the Asia-Pacific region. The Minister also reaffirmed the Government's wish to maintain Telecom and OTC in full public ownership and to ensure maximum possible Australian ownership of the telecommunications industry.

The Government saw network competition as the driving force for achieving its policy objectives. It envisaged across the board competition between the two carriers in both the domestic and international markets. AUSSAT would be freed of its restrictions from competing fully with Telecom/OTC and sold to form the basis of the second carrier which would have majority Australian ownership within five years.

In relation to industry policy considerations, the Government decided that both carriers would be free to choose and exploit technologies of their choice from around the world. However, the licence conditions of both carriers would provide for commitments to technology transfer, local research and development, local sourcing of equipment, and exports of locally developed products.

In defining its policy framework, the Government articulated 83 separate decisions, covering areas such as:

- competitive safeguards over the abuse of market power by Teleco/OTC as a result of its established presence in the market;

- arrangements for interconnect and access to the Telecom network and ancillary facilities;

- charges for interconnect and access;

- accounting separation of the activities of the second carrier and Telecom/OTC;

- price capping arrangements (*CPI-x*) for the dominant carrier Telecom/OTC to encourage productivity improvements and prevent predatory pricing;

- maintenance of Community Service Obligations (now called Prescribed Carrier Obligations) particularly to rural and regional areas, pensioners and people with disabilities;

- end of the First Phone monopoly on 30 June 1991; and

- provisions for the merger of Telecom and OTC.

The Government's decisions were laid down comprehensively in legislation. The Government also strengthened and enhanced the role and powers of Austel as an independent regulatory body to cover technical regulation, promotion of fair and efficient market conduct, protection of customers and the

achievement of industry policy objectives. Austel was also given a specific mandate to promote competition within the regulatory framework established by the Government's decisions.

2.0 COMPETITION

2.1 The Australian Identity

Such major changes coming on top of the changes promulgated in the May 1988 Economic Statement surprised many in the industry. After all, the revised *Telecommunications Act* and the Corporatisation of the Government Business Enterprises (GBEs) were less than a year old, and for years the tradition of telecommunications reform in Australia has been *steady as she goes.*

The way in which the changes were introduced indicates something about the Australian identity and, indeed, about this particular Labor Government. The package comprises an interesting mix of reliance on free market forces and, to make sure that they actually work the way they should, a bundle of supporting legislation and regulation. It clearly demonstrates the art of liberalisation, or deregulation through re-regulation.

The timetable that the Government set for achieving the changes was nothing short of breathtaking. No doubt the tight timeframe imposed on the proceedings owed much to internal party political considerations and to the Federal elections to be held in 1993.

However, while it would be easy to be critical of the rush, there is much to commend the Government's fortitude for sticking to its guns and driving both the public sector as well as its own internal political processes to ensure that the planned outcomes could be achieved within the timeframes it had set.

The problem confronting the Government was how to quickly change the culture, orientation and operations of a very traditional public sector PTT to a market driven, customer responsive, innovative telecommunications organisation operating essentially on commercial principles.

Unlike some other countries, the Government had made it clear that while it supported restructuring and liberalisation, it would not tolerate a *slash and burn* approach. The changes would need to take account of Australia's unique position and the Government's commitment to the achievement also of social objectives in the public interest.

It recognised also that the Australian telecommunications industry had grown up around Telecom and, by and large, embraced the same traditional PTT culture and attitudes. As the supporting industry would need to be an integral part of the restructuring, it too had to become even more competitive if it were to be able to operate successfully in the new environment.

Faced with these considerations, it could be argued that the imposition of a short, sharp shock would act as a circuit breaker, without causing undue and long term disruption to the industry. Because of the importance of the changes and the tight timeframes imposed for action, all concerned parties would have little option but to focus on getting the best positive outcomes within the parameters presented by the Government. To date, that strategy appears to have worked.

2.2 The Second Carrier

That AUSSAT should be offered for sale as the core of the second carrier has caused much debate. At various times it has been described as a "lemon" or an "albatross" for the Government. Various statements have been made about AUSSAT's

$740 million debt, implying that this is the extent of "wasted" taxpayers' money.

While such statements catch headlines and are easy to understand, they are also incorrect. By far the greatest part of AUSSAT's "debt" is normal private sector leverage leasing arrangements to cover payments for the replacement B-series satellites planned for launch in 1992. The Government has agreed to discharge the totality of AUSSAT's debt on its sale.

AUSSAT is a public company in which the Government is the sole shareholder. It is required under its Memorandum and Articles of Association to operate as a commercial, taxpaying enterprise, subject to certain public interest provisions. Most importantly, it has been prevented (until recently) by policy and legislation from competing directly with Telecom for the services it provides, and from engaging in international traffic.

Given the restrictions under which it has had to operate, the results that AUSSAT has been able to achieve are remarkable. AUSSAT has established a wide range of customers, principally in the broadcasting sector, and made possible a new range of services to people in outback and under-served areas as well as to downtown hotels and to clubs. It has also successfully planned and negotiated world-wide contracts and arrangements for the replacement B-series satellites, which embody leading edge technologies.

In presenting AUSSAT as the nucleus of the second carrier, the Government is privatising a valuable asset with an established customer base. AUSSAT also has many experienced professional staff who know and understand the operations of Telecom and OTC extremely well - most of them came from there!

3.0 CARRIER SELECTION

3.1 The Selection Process

The selection process for the second carrier licence (and also for the second mobile licence) was the sale of AUSSAT. In the early days leading up to the process there had been a number of wild guesses at the appropriate level of licence fee. Some argued figures of around $1500 million, while others had equally expansive figures on the potential worth of OTC when it was thought to become the core of the second carrier.

Such speculation obviously caught the attention of the cash-strapped Government, which anticipated a generous second carrier licence fee, as well as expecting Telecom to pay a fee to the Government for the acquisition of OTC to become the merged Telecom/OTC.

The Government established a Second Carrier Selection Team comprising representatives from a number of Federal Departments to administer the selection process and advise the Minister. It invited initial expressions of interest on 5 December 1990 and foreshadowed a staged process through firm proposals to requests for tender, to be completed by December 1991. Another task group was established within the Department of Transport and Communications to be responsible for the Implementation of New Carrier Arrangements (INCA).

Perhaps the most difficult task was sustaining and supporting on-going consultation with the industry and potential stakeholders. The timeframes were already tight, and the time that could be made available for outside parties to consider and comment on draft legislation and conditions was necessarily short. However, the consultative process was essential for bringing about a result that would work. By involving all parties in the process,

any difficulties could be identified at an early stage and, where possible, agreed solutions achieved.

3.2 The Selection Criteria

The Government's principal objectives to be achieved through the second carrier are to improve the standard and range of telecommunications services, and to reduce costs to consumers both residential and business.

The Government also announced that in assessing proposals, it would attach particular emphasis to the following criteria:

- the ability and commitment of potential investors to compete effectively in the Australian telecommunications environment;
- the financial strength and managerial capabilities evidenced in the proposed corporate entity, and a proven track record in planning and operations in the telecommunications field;
- commitments to bring tangible benefits to Australian industry, through technology transfer, contributions to Australian research and development, local manufacturing opportunities and support for exports of products and services;
- arrangements for achieving majority Australian ownership of the second carrier on a planned agreed basis within five years;
- price and related payments, although these would not be the sole determinants of selection.

The RFP sought innovative proposals from prospective bidders for AUSSAT which addressed the above criteria and detailed how their proposals would lead to development opportunities for Australian industry.

3.3 Industry Policy Considerations

One of the issues that was given considerable attention throughout the selection process was the strength of the Government's commitment to industry policy arrangements. What should have been a relatively clear cut issue became clouded by much uninformed debate.

There was a perception that because the Government had adopted economic rationalism and competition through free market forces as its approach to the economy, it was not serious about the industry policy requirements for selection of the second carrier. This caused concern to Australian firms, who considered that without the commitment of the major players, they could be locked out of local network development or denied access to regional markets dominated by the majors, irrespective of the quality of their products and services.

The Government established a Ministerial Advisory Committee (the MAC), chaired by a prominent Parliamentarian, with a number of expert advisers drawn from various sectors of the industry to consider and advise on a range of industry issues.

4.0 STRATEGIES AND ALLIANCES

4.1 The Emerging Players

In response to the Government's advertisement in December 1990, over thirty expressions of interest were received. None of these was announced, but various players became public during the process and the Government welcomed such keen competition for the second carrier licence. It was known, for example, that a number of the RBOCs and major European telcos were among the contenders.

As the process moved into the second stage in March, however, there were a number of departures from the competition. Among these were Nynex and British Telecom, whose withdrawal created much speculation in the industry. Some argued that in seeking a high licence fee and making AUSSAT the centre of the second carrier, the Government was making the game too tough. Others claimed that there were few credible bidders left in the race and the Government could not sustain effective competition for the carrier licence.

There was much speculation about which firms were left in the race and what their chances were likely to be. The presence of major Australian industrial and financial companies also created interest. Ameritech and Bell Atlantic, fresh from their triumph in New Zealand, were rated highly, as were BellSouth and Cable and Wireless.

4.2 Competition and Cooperation

It was an exciting time in Australia! Everyone was courting everyone else (or others claimed they were) as the pace hotted up. It was not long, however, before two consortia emerged - an American led group with the Aboriginal name Kalori, and a US/UK alliance with the unfortunate acronym ACE (Australian Communications Enterprise).

The Kalori group comprised Ameritech and Bell Atlantic, together with the Hong Kong based Hutchison Whampoa. ACE comprised BellSouth and Cable and Wireless, and several major Australian investors including Mayne Nickless, AMP, National Mutual and the AIDC. While names such as Bell Canada and AT&T were mentioned, they could not be tied to any consortium.

The campaigns conducted by Kalori and ACE were very different.

BellSouth continued its high profile activities and initiated wide-spread dialogue with Australian industry. It was open about its plans for network competition and in effect invited "tenders" from Australian firms for the inputs they could provide. In this way ACE sought to demonstrate that they were serious about industry policy and had a number of Australian firms already "signed up".

By comparison, Kalori made few public statements. No doubt it was making its *due diligence* inputs to the Second Carrier Selection Team, but it was losing the war of words and lacked public visibility. Its plans, other than for mobile, were held close to the chest. It did not seem to appreciate the importance in Australia of maintaining a positive image of the consortium before politicians and the public.

Some have argued that this was really a strategy to have contenders under-estimate the Kalori bid, while they quietly presented their winning case to the Government.

4.3 Strategic Alliances

While the major competitors for the second licence sought to position themselves with the appropriate mix of joint venture partners, the smaller industry players were also taking a hard look at market opportunities both in Australia and in the Asia/Pacific region.

It was too early to pick winners, but the firms noted that the members of both ACE and Kalori had considerable leverage in the regional markets. While it was very attractive to "sign up" with one or the other, the risks of exclusivity were obvious, including the potential reaction by Telecom, their existing major client who would remain the dominant purchaser for some years.

The keen competition proved to be a catalyst for the more entrepreneurial Australian firms. Looking beyond

the second carrier, they saw the need to be aligned with a major world class supplier who complemented their capabilities and had access to regional markets and new technologies. By remaining neutral, they could retain their existing favourable supplier status with Telecom, while presenting themselves to ACE and Kalori on their merits, hopefully with a major world supplier lending weight to their claims.

An excellent example of regional cooperation was the forging of a strategic alliance on 13 June 1991 between Exicom Limited, Australia's largest domestically owned telecommunications and electronics manufacturer, and the international telecommunications giant Northern Telecom Limited. The alliance positioned NorTel Australia Pty Limited, Northern Telecom's local subsidiary and Exicom to take advantage of the rapid changes in Australia and in the Asia/Pacific region.

Both companies are targeting initial joint manufacturing and marketing initiatives to yield at least $10 million in exports in the first year. The partners are establishing an Australian Development Centre at Exicom's modern manufacturing facilities in Sydney, supported by a technology transfer program from Northern Telecom. The Centre will provide specialist local development and adaptation of NorTel products to meet the stringent requirements and standards of the Australian licensing authorities, the carriers and resellers.

The focus of the initiative is on both developing a comprehensive manufacturing base for NorTel and establishing the required level of customer service and support, drawing on a base of technological excellence and strict quality assurance. The Centre will apply its research and development capability to extend the range of Exicom and NorTel product packages, with a particular focus on leading edge technologies to meet the specific and often unique needs of regional markets.

This alliance has been a positive response to the changes in the telecommunications environment. It has been well received by the Government and the major players, and should provide long-term benefits to both firms.

4.4 Industry Arrangements

For many years Telecom Australia had encouraged the development of the Australian telecommunications industry under its local sourcing policies. Given Australia's geographic location, population distribution and relatively advanced economy, such support owed as much to enlightened self interest as to national pride. The result has been a small but efficient telecommunications industry well versed in advanced technologies, with particular skills in developing and adapting overseas equipment and software to meet Australia's unique needs.

Firms were concerned, however, that the imminent pressure of competition from the second carrier could force Telecom to pursue a "lowest price" purchasing philosophy. They also recognised that unless some constraints were placed on the consortium of overseas players that would control the second carrier, transfer pricing could result in equipment being supplied internally from the corporate giants overseas. Similarly, because of the dominance of regional markets by the majors, access to export markets could be extremely difficult.

Leading Australian firms co-operated to formulate industry policy arrangements for the period of the carrier duopoly until 1997 and beyond. Considerable consultation was involved and the views and fears of key Government Departments and Ministers were taken into account.

The arrangements were built on commercial principles rather than on protectionist lines, while ensuring that Australian firms would be given the opportunity to compete.

The resulting policy generally met with the approval of all key players. It was also very similar to the industry development arrangements formulated by the MAC.

5.0 THE SECOND CARRIER

5.1 The Final Bids

The timing for the selection of the second carrier was extremely tight. Several streams were pursued in parallel to ensure that the legislative backing was in place to support implementation of the decisions. Decisions by Austel were also awaited on issues such as the price of interconnect and the associated arrangements. Nevertheless, firm proposals were invited on 26 March and, despite various withdrawals, on 31 July two consortia were invited to make their final offers.

The reduction of competitors from over thirty to two could have been embarrassing for the Government had it not been for the impeccable qualifications of the contenders. ACE had been quietly re-named Optus Communications, which it was explained came from the Latin *I choose* (and not "opt US" or "opt us"). It was rumoured that Kalori was soon to gain yet another large and powerful partner, although guesses ranged from AT&T to Bell Canada, and that British Telecom would re-enter the race.

The third contender to lodge a bid in early July was COMSAT. However, the Government did not believe it appropriate for COMSAT to be shortlisted, because its proposal addressed only satellite technology applications. It suggested that COMSAT would be free to pursue its ideas with Optus and Kalori.

Final offers were due by the end of October. Optus widely canvassed industry participation possibilities and sought to respond to the weight of paper presented to the competing consortia by the Second Carrier Selection Team. There was much debate about the real value of the licence fee and indeed of AUSSAT, particularly as to how this would affect Australia's ability to leverage an acceptable return for its sale.

Many argued that AUSSAT would be more attractive if the Government agreed to Pay Television. The first time around it was rejected by the Caucus, but as the competitive edge wavered, the Government gave the go-ahead for Pay-TV on 9 October (at least in principle) and reserved the national license for satellite delivery via at least four AUSSAT channels. The push had been from some quarters for optical fibre cable delivery by Telecom.

This was seen by many as a means of trying to make the AUSSAT sale more attractive, but at that time dire rumours were circulating. Despite the addition of France Telecom to the team, the imminent collapse of the Kalori consortium was reported in the *Australian Financial Review* on 22 October. The news was confirmed on 24 October in a press release by Ameritech, Bell Atlantic and France Telecom. They advised that the decision resulted from a realisation that the final business plan developed by the Kalori consortium was not a strategic fit with their companies' investment criteria.

The interesting outcome was that Hutchison decided to pursue the bid on its own as Kalori. It also announced an alliance with AT&T and an Australian link through AWA.

Meanwhile, Optus had announced NorTel as its primary switch supplier, Nokia for GSM mobile and Exicom as a key Australian supplier and systems integrator. It was also quite open about its network rollout plans and employment strategies.

5.2 The Decision

Both Optus and the modified Kalori submitted their final offers early in November. The bids were quite different, with Optus offering fixed links to provide network competition, and Kalori stressing wireless links and reliance upon the existing optical fibre network capacity of Telecom to avoid "wasteful" duplication.

By 19 November it was all over. The Government announced that it had selected Optus to be the second carrier. Optus would pay to the Government a total of $800 million (which would nicely cover AUSSAT's debt and leverage leasing arrangements of $740 million which the Government had agreed to discharge on sale) and invest almost $2000 million over the next six years in the network. Optus also committed to achieve 70% Australian content in its capital investment in equipment supply and installation. It expected that over the next five years 5000 jobs would be created, with $100 million committed to training.

Because of its Australian joint venture partners, Optus would have 51% Australian ownership from the outset, exceeding the Government's requirement to achieve majority Australian ownership after five years.

The Government expects contractual documentation to be finalised in time to enable completion of the transaction on schedule by 31 December 1991 as planned. The overall effort over such a timeframe is remarkable and a credit to all participants, including the industry players who had to drive very hard to meet the tight and continuing deadlines.

6.0 UNFINISHED BUSINESS

6.1 Competition

Network rollout will be rapid. Long distance and international services are expected to start from Sydney in late 1992. A competitive mobile telephone service will begin in early 1992, using resale of air time on the present Telecom analogue MobileNet system to establish market presence. It will be some time, however, before practical assessments can be made about the benefits of competition.

The industry policy arrangements for which the leading firms fought hard to achieve will be reflected in the licence conditions for the carriers, which will have the force of law. However, because this requires amendments to legislation, the statutory process would have left the amendments tabled and subject to disallowance by both the Senate and the House of Representatives for fifteen sitting days. This would have deferred the licence conditions into 1992.

To overcome this potential difficulty, the Government simply moved an amendment changing the statutory time from fifteen days to five.

The Government made what was thought to be a "brave" decision in selecting GSM for the digital mobile telephone technology to replace the existing analogue systems. With the rapid changes in technology, some are already asking whether GSM has already been passed and are we not into the realm of PCN. This will have interesting implications for competition in mobile services, particularly as the Government has re-affirmed that expressions of interest for the third mobile licence will be invited in early 1992, with service expected to begin in 1993.

6.2 Regional Co-operation

The introduction of the processes leading to competition have already had a considerable effect in forcing Australian firms and their strategic partners to take a wider view of their market opportunities. Some have started to position themselves not

only to deal effectively and competitively with the carriers, but also to focus on export opportunities in regional markets. One of the challenges is which products? and which markets?

The growing commercial importance of telecommunications has forced even the larger players to take the implications of globalisation into account in their planning and marketing. In the '90s we have seen individual competition give way to co-operation in the pursuit of markets. While there are still opportunities for smaller firms to capture niche markets, the increasingly high cost of proving technology applications provides a strong incentive for co-operation so that costs and risks can be shared.

Contrary to popular past perceptions, regional markets are fast becoming more challenging. As economies develop and the population becomes more demanding and discerning, it takes skill, understanding and patience to establish a lasting market presence. While the large global players have established markets around the world, their very size makes it difficult and expensive for them to configure their products to meet particular local needs.

It is in these situations where the capable smaller firms are able to create new opportunities. Their greater flexibility and often regional understanding complement the access to technology of the global firm and the corporate resources it can make available. Such symbiotic relationships in the decade of the '90s herald the era of competitive co-operation.

Handled sensitively, competitive co-operation can unlock a wealth of alternative futures for the emerging nations of the Asia/Pacific region. In establishing such arrangements, Australia is already playing a leading role.

Restructuring of the Global Information Industry and the Resulting Demand for New Skills

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1. ABSTRACT

The ongoing restructuring of the information industry affects a wide range of constituencies. Good models are needed to guide our understanding of the relationships among industry sectors; existing models are discussed together with suggestions for an alternative approach. Issues relating to the appropriate education and training of the workforce needed by the restructured industry are raised.

2. THE INFORMATION INDUSTRY

2.1 Convergence and Competition

The 1990s are providing unprecedented opportunities--and risks!--for telecommunications organisations. Many of those that have enjoyed virtual monopolies over a well-defined set of products and services are facing competitors in established markets and the challenge of capturing new markets for hybrid products and services based on converging technologies.

And the field is rather crowded. As Jonscher (1) points out, enhanced information processing functions to support new products and services can, in many cases, be provided equally well by computers and intelligent terminals *or* by value-added systems *or* by transmission links and switches. This leads not only to competition among various types of firms in the computing field but to a new level of competition between computing and telecommunications. With the advent of digital audio, whose transmission system may be merged with other digital communications streams, broadcasting also enters the picture.

We believe, therefore, that the strategies for capitalising on the new business opportunities will be more effective if telecommunications is regarded as an integral (albeit the largest) part of a broadly defined information industry whose primary sectors--*telecommunications*, *computing*, *broadcasting* and *publishing*--are becoming more integrated at the level of technology but more competitive at the market level.

We aim to explore this convergence and competition in our paper, and to point to the need for good maps and models of the information industry to guide strategic decision-making.

2.2 Constituencies Affected

Many constituencies stand to benefit from a clearer understanding of the evolution, structure, regulation, activities, relations among and economic importance of the various sectors of the information industry. Apart from *telecommunications organisations* themselves, these include:

economic planners, who see the information industry not only as a dynamic activity in its own right but as a core industry that enables others to develop and, therefore, as a catalyst for economic growth;

national and regional governments, who must make public policy on indigenous information-industry development and regulation, as well as on the control of national and international information flows;

international organisations, who represent the social, political and cultural views, as well as the economic interests, of their constituents in relation to the "new world information order" (a UNESCO phrase);

transnational corporations, whose operations depend on the unimpeded flow of corporate data through international public and private networks;

service industries, who see in the application of new information technologies the potential for big increases in the tradeability of their services (banking, insurance, marketing, etc.);

production industries, who look to such new technologies as CIM (computer-integrated manufacturing) for productivity improvements to render or keep them competitive;

information-industry entrepreneurs, who control a major growth industry, which also provides the infrastructure and services that enable other industries to develop;

information professionals, who possess the expertise on which the information industry depends for research, development and applications, and who need to be able to plan careers that could involve mobility among the various industry sectors; and

educators, who must understand the dynamics of the information industry so that they can maintain curricula that give graduates and trainees knowledge and skills that are relevant in a constantly changing marketplace.

3. THE FORCES OF CHANGE

3.1 Market Factors

Some of the forces that are bringing pressure for restructuring of the information industry are also affecting other industries at this point in history.

They include: globalisation of markets and production facilities via the establishment of transnational or multi-domestic corporations; the concomitant push for liberalisation of world trade, as overseen by such institutions as the GATT (General Agreement on Tariffs and Trade); the emergence of powerful regional trading blocks, such as the 12-nation European Community, which enable nations to trade in markets much larger than their home bases and give them strength in numbers in their dealings with other regions; plus a spate of mergers and takeovers by companies seeking to take advantage of the "economies of scale" offered by global trading.

Other forces are peculiar to the information industry: they include the continuing pressure for re-regulation of telecommunications and broadcasting; and changes in the relative world market values for individual communications versus mass-communications, where declining computing and networking costs have rendered the former competitive with the latter and opened up a whole new slate of opportunities for both buyers and sellers.

3.2 Technological Factors

The single most important technical influence on information-industry restructuring is the digitisation of all the forms of information representation (voice, video, data, images and text) which permits information that formerly was carried separately (e.g., voice traffic by telephone companies and video traffic by television companies) to be handled in common with all other types of information. Thus, according to a recent OECD (Organisation for Economic Co-operation and Development) report (2), technology is becoming of less importance as a limiting factor constraining innovation. Instead, "it is other factors, such as pricing, quality, marketing, and the level of demand which determine the success of new products and services." Each of the industry sectors must recognise that its technology no longer necessarily gives it an exclusive advantage over competing sectors in specific applications.

The implications of technological convergence are far-reaching. Armstrong (3) speaks of "services which can leap the existing legislative boundaries"; and problems arising from the existence in many countries of separate regulatory agencies for broadcasting and telecommunications have been well documented. Public policy and regulation must, in future, be formulated for a more integrated information industry; once again, we sense the urgent need for good maps and models to guide the process.

4. MAPS AND MODELS

4.1 Earlier Approaches

Among the best-known attempts at illustrating the information industry and its constituent parts are the "Map of the Information Business" devised by members of the Harvard Program in Information Resources Policy (4) and the "Model of the Integration of the Information Industry" designed by Larry Day for the [American] Information Industry Association and reproduced on the cover of their annual directory (5). These will be described briefly below, together with a model of "The Structure of the Information Industry"

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produced in a recent OECD report (6) and a pie-chart showing the "Market Size of the Information Industry [in 1986 and 2005]" with the relative share for each sector, published by the Japanese NTT (Nippon Telegraph and Telephone) in 1990 (7).

Although devised for different purposes, the following methods all share one important attribute: they use the singular "information industry" (or "business") to more accurately reflect a growng degree of interdependence as the formerly distinct industries of telecommunications, computing, broadcasting and publishing are being restructured:

The Harvard Map of the Information Business positions various information products and services strategically on the map so that a series of overlays can be used to highlight different aspects of the industry, for instance, its historical development, patterns of government regulation and deregulation, areas of operation of specific firms, diversification of special interests (newspapers), products and services involved in office automation, and so on. The map has proved to be a useful tool for tracking the dynamics of the U.S. information industry.

The Information Industry Association's Model aims to show the continuing integration of the industry sectors. It is divided into eight parts: Content Services, Content Packages, Facilitation Services, Information Technologies, Integrating Technologies, Communications Technologies, Communications Channels and Broadcast Channels. The various products and services are allocated within these divisions, the implication being that the closest integration is to be found between neighboring sections. The Association, founded in 1968 to serve the interests of entrepreneurs in the Content areas, now boasts members in all eight segments.

OECD's Structure of the Information Industry details the three core technologies: computing, communications and broadcasting, the range of hardware needed to support this core, and the types of software and services it generates. It distinguishes between the traditional dominant modes of communication in each of the areas: many-to-one (computing), one-to-one (telecommunications), and one-to-many (broadcasting). The perspective for this model is the *convergence* arising from the digitisation of the three underlying technologies.

The 1990 NTT Pie Charts of Market Size of the Information Industry [in 1986 and 2005] are of interest here because of the four-way sectoral breakdown they use: *telecommunications; information processing; broadcasting;* and a fourth sector that includes "mail, newspapers, *publishing*, etc." The change in the relative share of the pie among sectors from 1986 to 2005 reveals an increase in the information processing share at the expense of both telecommunications and the mail/newspapers/publishing sector.

4.2 An Alternative Approach

Each of the maps and models described above aims to allocate products and services of the information industry among various designated sectors. Mansfield is experimenting with a new approach based on the following premise.

Industry developments are increasingly geared toward providing consumers with more choice among alternative methods of achieving the same results, thus facilitating the substitutability of products and services from various sectors. This being the case, it seems worthwhile to look at the industry from the point of view of *the information functions users will want to perform* and build the model on the basis of an analysis of which sectors can service which functions. This approach may give fresh insights into the true degree of overlap--and consequently of competition--among sectors.

5. THE DEMAND FOR NEW SKILLS

5.1 The Importance of Skills

Whichever models are used to help us to understand the restructuring of the information industry, one thing is certain: the requirements of its various sectors for appropriately skilled professionals and workers will need urgent attention. There are a number of reasons for this:

1) human resources are becoming a new competitive parameter and strategies are being adopted to coordinate the development of both physical *and* human resources;

2) the need for quality and reliability is forcing firms to consider more integrated strategies for managing new technology, work organisation and skills--rigid 'Fordist' or 'Taylorist' standards

are being replaced by more flexible human-centred approaches; and

3) reductions in the availability of unskilled jobs mean that newly created jobs may be more demanding and require multi-skilling (the process--e.g., job rotation, on-the-job training--through which workers are equipped to perform many different tasks within a flexible work organisation).

The Organisation for Economic Cooperation and Development (OECD) has identified three levels at which convergence of different sectors of the information industry can be understood: *technical*, *service*, and *corporate structure* (8). By considering each of these levels in turn, some general trends relating to skills can be identified.

5.2 Skills at the Technical Level

At the technical level, the shift from analogue to digital technology is blurring boundaries, not only between industry sectors but at the level of the technology itself. For example, it is likely that future trends will be characterised by:

- multimedia networks using a hybrid of fibre, copper and wireless;
- multi-service networks carrying a selection of different services (perhaps from different service providers) over the same network;
- multifunctional terminals incorporating a variety of different computational, communicative, and visual functions (9).

The implication is that professionals will need to have knowledge of the major network technologies--namely, fibre, cable, satellite, and mobile communications. At the process level, digitisation of these networks will require skills (e.g., digital programming) that are applicable across the range of networks.

For example, the fact that data and voice traffic are increasingly being carried over the same network is requiring 'integrated' people who are capable of managing this integrated service. While, in the past, individuals may have had a strength in one area or the other, to be effective in future, professionals will need to understand the requirements of both areas of technology (10).

As competition moves to multi-service networks, it will no longer be enough for the professional to know only about technological factors. Increasingly, as we indicated earlier, competitive pressures based on quality of service, pricing, marketing, and demand considerations will require that they be acquainted with these issues in order to effectively participate in teams or projects. In addition, the globalisation of networks and services will require some knowledge of worldwide technical standards and regulation, the legislation governing international information flows, and markets.

5.3 Skills at the Service Level

At this level, the advent of hybrid services (e.g., data broadcasting, narrowcasting and interactive services) is making it difficult to distinguish the various information industry sectors solely on the nature of their service and how it is communicated. As we argued above, there is now considerable overlap between the traditional functions of telecommunications, computing, broadcasting, and publishing; for instance, it is possible for newspapers to be transmitted electronically and data services to be distributed via broadcast channels.

The familiar employment patterns of arts graduates going into broadcasting and engineering graduates into telecommunications may break down with the overlap in services. While knowledge of a disciplinary area will continue to be required, there is likely to be increasing demand for professionals who have cross-disciplinary skills. The blurring of services and the media by which they are conveyed will be largely determined by government regulation. If markets are to be structured in this way, then knowledge of regulatory regimes will be essential also.

5.4 Skills at Corporate Structure Level

At the level of the corporation, telecommunications organisations, computer companies and media conglomerates are restructuring in order to capture markets in a broad range of activities including the provision of networks, interactive services, information delivery, value-added services, and news gathering and dissemination. Mergers, acquisitions and strategic alliances are being formed among information-industry firms all around the globe.

In view of these demands, future managers will have to be conversant not only with investment opportunities but also with cultural factors and regulations at the international level.

Change in corporate structure has implications for human resources, particularly in relation to the categories of staff employed. For example, Koenig has pointed out that the major insurance company, The Travelers, forecast that for the decade 1980-90, the ratio of its professional to non-professional staff would be reversed from 10,000 professionals and 20,000 non-professionals to 20,000 professionals and 10,000 non-professionals (11).

Within organisations, the previously separate information service departments of a company may need redesign to respond to convergence. It may no longer be feasible for the functions of data processing, research and development, telecommunications, and the library to be administered separately. These challenges will require managers who have skills in innovating, as well as company restructuring (12).

5.5 Major Themes

The major themes arising from the above observations are that while specialist knowledge of a disciplinary area will continue to be important, there is increasing pressure for professionals to have some knowledge of related disciplines. Multi-skilling, which is already evident in manufacturing, will continue to be an important feature of human resource development. The progress of digitisation will require more widespread knowledge of this technology. In addition, the ability to manage projects and work in teams is likely to be an increasing requirement in the workplace.

6. RESPONSES TO CHANGING SKILL NEEDS

Industry, educational institutions, labour and governments must develop strategies to cope with the human resource implications of the restructuring of the information industry, particularly that of its largest sector, telecommunications.

6.1 Industry

Industry is perhaps best placed to respond to the demand for new skills. At the highest level, management will need to ensure that human resources are factored appropriately into planning. Strategies which continue to replace labour with capital may have some short-term attraction but could be costly in the long term. Management that is not prepared to embrace multi-skilling practices and human-centred work structures could be limiting its company's ability to move into new markets, especially in a deregulated environment.

The role of information as a resource has to be recognised and managed appropriately. On-the-job training for employees may well need to be supplemented with frequent opportunities for formal education and re-skilling. Company re-organisation may encourage cross-training. For example, employees who have experience in computing may be encouraged to take positions in the telecommunications department; in that way, skills can be broadened. And internal company programs to enable all staff to become familiar with new technologies being introduced in the organisation should be encouraged. A way in which companies can recruit suitable staff is to offer scholarships or work experience to graduates training in a particular discipline. The knowledge gained from formal education can be enhanced by the experience gained from working in a related but different technology or division of the company.

Unless stronger links are fostered between industry and educational institutions, opportunities may be lost. Likewise, failure of management to improve opportunities for multi-skilling at all levels could expose the organisation to increased tensions with labour as job domains and design inevitably change.

6.2 Educational Institutions

Educational institutions have a responsibility to be abreast of the major technological, social and organisational changes affecting the information industry. At one level, degree courses should reflect the integrated nature of restructuring. Students should be exposed to other technological systems which relate to their areas of expertise. For example, a computing graduate would benefit from some knowledge of telecommunications engineering. This interdisciplinary approach is even more important if the skills of teamwork, project leadership, communication, and knowledge of business and political factors are included.

The academic location and design of interdisciplinary courses will be an important factor not only in their success but also in promoting

a fresh approach to education for the information industry.

As the study of the legal, political, economic and managerial aspects of the information industry grows in importance, it may make sense for these subjects to be taught in conjunction with technical subjects. The cross-fertilisation of the social and the technical dimensions would be enhanced if technical faculties were willing to undertake teaching in such areas as strategy and policy formation, once thought to be the sole preserve of arts faculties. This refreshing approach would help to increase the value of course offerings to students, break down disciplinary boundaries no longer relevant to industry, and promote research that is truly interdisciplinary (13).

Upgrading the skills of managerial and professional staff through postgraduate programs is another area where educational institutions can play a valuable role. Appropriately designed courses would allow professionals to gain an understanding of new technologies and their likely trajectories, as well as a broader knowledge of political, economic and regulatory issues affecting the information industry.

Educational institutions must face up to the fact that the latest technology and expertise will often lie outside their campuses. Encouragement and funding for university-industry interchange will be necessary to keep staff knowledge and curricula up-to-date.

6.3 Labour Organisations

Labour organisations, too, will need to be more flexible in their approach to job specifications and skill requirements. While unions have traditionally been strong supporters of staff training, the changes brought about by convergence of information technologies is threatening the very foundations of the unions themselves.

Although the restructuring of the information industry may reduce the number of jobs, the potential for productivity gains could act as an incentive to unions to facilitate and even shape the process of change. With higher productivity, redundancy packages may become more generous, income levels higher, and retraining opportunities more widespread. In this way, the immediate disadvantage of job losses can be counterbalanced by innovative approaches to work design, skills development and training.

6.4 Government

Finally, government has an important role to play in skill enhancement. At a general policy level, government can encourage skills formation by introducing regulations that acknowledge the potential for technological and service integration. This means that regulation will concern itself more with access to, and interconnection of, networks and services rather than relying on specific technological regimes (e.g., satellites, telecommunications, newspapers). Putting artificial boundaries around particular technologies will inevitably lead to market distortions.

More specifically, government will have a continuing role to play in providing a sound educational foundation for future skills development. It should not leave vocational education solely to industry. Government will need to continue to provide a good standard of 'liberal education' as well as the usual opportunities for vocational training. Government encouragement of closer links between industry and educational institutions will be vital.

One mechanism to improve these links would be through the facilitation of short-term exchange between educators and employees in industry. This would promote skills transfer (14). Other possible mechanisms include joint research programs using technology that is shared by industry and the educational institution, and joint sponsoring of courses that are tailored to the needs of particular companies.

6.5 The Quality of the Response

How well the above groups will respond to change will depend on their understanding of the nature and dynamics of the information industry and their willingness to adopt ways that are human-centered, innovative and flexible.

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New Directions In Asian Telecommunication: The Soviet Equation

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ABSTRACT

The jurisdictional debate over control and oversight of telecommunications activity in the former Soviet Union is at the heart of a basic policy debate within the USSR. Soviet authorities are advocating the evolutionary development of a "Trans-Soviet Line", which on economic and security grounds would constitute a national "backbone" for an integrated, nationwide communication system linking the two extremes of the USSR. This Line would also be used for the purpose of enabling the Soviets to capture hard currency earnings by transiting international calls from West Europe to Asia over their own territory and, of necessity, would link the USSR with contiguous international networks. The initial building blocks for this network are to be installed in various key localities, Moscow, Leningrad and Kieve, where the Soviets have proposed to install international "gateway" switches. At the same time, various republics and municipalities are in the process of exploring other forms of gateway projects which would establish international connections for the republics in their own right and which could also serve "national" purposes by interconnecting European and Asian USSR, albeit via networks transmitting North America. Moreover, republic authorities, or subdivisions thereof, have indicated the desire to establish their own international and regional gateway switches.

There are more issues than answers. For example, the various draft treaties, as well as existing laws, do not indicate the recipient of the revenue from an international system, who receives the interest, nor who controls the traffic. If the Soviet national government uses the facilities of the republics then must the national government pay the republic rent? Will parallel telecommunications systems of the republican governments and the national governments compete? What of the role of purely extreprenurial systems?

The outcome of such debates as well as general issues pertaining to joint venture organization and access to foreign exchange will control the evolution of the largest territorial market in Asia and the most important new laws of telecommunications development.

Various initiatives at the Republic level may contribute to the ultimate answers to such questions. With respect to the controlling legal standards, the Republics are clearly taking charge of their economic destinies. The November 15, 1991 edict relating to "Liberalization of Foreign Economic Activity in the Russian Soviet Federated Socialist Republic" promises sweeping change in the international activity of business entities and ordinary citizens alike. The decree exempts the Russian Republic from central Soviet regulations about foreign economic activity, including import, export, tax, duties and foreign economic activities. Conversely, as a basic element of sovereignty, the edict establishes the primacy of Russian currency. Foreign exchange settlements of local transactions are prohibited. This principal minimizes the hard currency exposure of telecommunications and other joint ventures to local service organizations, thereby conserving foreign exchange for the importation into Russia of western-source goods and services. The decree will also benefit foreign investors in repatriating profits and dividends, but will also limit local companies in terms of their purchase of foreign exchange for imports. This restriction makes sense because, it is fair to assume a chronic deficit of foreign exchange reserves until Russia will be able to balance its foreign trade; hence, limited licensing. Other measures likewise will restrict the access of purely local enterprises to foreign exchange reserves, including a requirement that local enterprises sell part of their foreign exchange receipts an exchange rate that may be different from the freely convertible one.

In sum, the decree sets an eloquent background for free trade and convertibility and a reasonable balance of controls providing for their orderly development.

Introduction

Telecommunications has historically been neglected in the Soviet economy because of a "prejudice against 'nonproductive' activities." (1) In the highly centralized economy, a public telecommunications network was not required for business purposes, and Soviet leaders were wary of citizen access to communications facilities. The telecommunications system was designed to serve official and administrative rather than household needs. The Soviet network evolved as a rigid hierarchical structure which responded poorly to user demands.

President Mikhail Gorvachev initiated reforms of the highly centralized structure, and the administration placed telecommunications at the forefront of development and growth. One million new lines were installed yearly from 1980 to 1985, and two million were added each year from 1986 to 1990. The network was altered to make residential service a priority.

Even before the failed putsch, decentralization of the telecom organizational structure began. Two levels of authority existed - one at the All-Union level and the one at the

Republic level. Traditionally, the two groups did not work well together, and this strain hindered productivity. Gorbachev's perestroika improved this relationship by changing laws and granting Republic Ministries greater independence and responsibility.

In April of 1991, the Deputy Minister of Soviet Communications, Kalijeu Kukk, predicted that the role of the All-Union Ministry, eventually, would be very close to that of the FCC in the United States - a body limited to unifying standards, regulating and licensing throughout the Soviet Union. (2) Prior to the unsuccessful coup, an agreement was signed between the Federal Ministry of Communications and the Republic Ministries of Communications stipulating distribution and sharing of functions and responsibilities. In July of 1991, First Deputy Minister of the Soviet Ministry of Communications, G.G. Kudriavtsev, reflected that the agreement had indeed resulted in heightened coordination of activities carried out among the Republic ministries.

During a session at Telecom '91, Yuri Gulyaev of the Soviet Academy of Sciences, (formerly and perhaps presently Chairman of the Supreme Soviet subcommission on Telecommunications) said that most telecom decisions will be made at the republic level, and the Soviet Union is in need of a central body like the American FCC to administer telecom standards for the various republics. Gulyaev was to propose legislation in the latter part of October 1991 making the activities of the all-Union MPT similar to those of the FCC.

Another aspect of telecommunications touched by perestroika was Gostelradio. President Gorbachev announced in 1990 that he intended to abolish Party control of broadcast operations and ensure the "democratization of the airwaves" by allowing political parties access to the air. Also in 1990, the Soviet Union revealed plans to abolish its censorship organization, Glavit, which for decades was the guardian of the Communist Party line in literature and the arts. Glavit was to be replaced by Guot, an organization concerned with guarding state secrets.

Background

Telecommunications development first appeared in the Soviet Union's 1966-70 Five Year Plan, which called for a Unified Automated System of Telecommunications (EASS). The EASS was to be an integrated network with the capacity to carry voice, video and data traffic. However, little integration took place during the five year period.

The focus upon telecommunications increased in the 1980s. In 1985, the Central Committee and the Congress of the Soviet Communist Party called for a restructuring of the Ministry of Communications. The Prime Minister initiated a program for telecom growth and converted some military communications manufacturing to civilian production. The five-year plan from 1986-1990 sought to add 12.1 million new lines to the system, shift to semi-electronic exchanges, and introduce fiber-optic and digital technology. The plan's emphasis was on residential systems, and 75% of the new installations were to be residential.

The goal of MinSviaz, the Ministry of Communications, was to reach 90-100% urban penetration and 50% rural penetration by the year 2000. Attaining this goal would require the installation of 60 million lines in the 1990s. Yuri Gulyaev outlined the development goals as transition to a digital network, and the deployment of fiber, cellular systems, and satellite communication links.

Former Organizational Structure: All-Union Level

Telecommunications facilities, service and manufacturing operations were state monopolies under the Federal Ministry of Posts and Telecommunications (MPT). Coordinating overall telecom policy, the All-Union MPT was responsible for manufacturing all telecom equipment, developing technical standards, and creating a pricing policy for services of an all-union nature, i.e. long distance and international telephony. New equipment integrated into republican networks had to conform with technical standards provided by a special commission.

An All-Union Ministry of Communications (MinSviaz) operated national and international networks and services, as well as postal services and television and radio broadcasting. The reach of MinSviaz extended to the building, maintenance and operation of facilities for TV and radio broadcasting. The internal organization of Minsviaz consists of a collegium, a scientific-technical council, and a number of Chief Administrations (glavne upravleniia or glavki). The latter included the Chief Administration for Science and Technology (GNTU), the Chief Administration for Industrial Enterprices (GUPP), and the Chief Administration for Satellite and Radiobroadcasting (GKRU).

Prior to its abolition in 1989, the Ministry of Communications Equipment Industry (Minpromsviaz) carried out all production and installation functions. Minpromsviaz was supplied with components and equipment by the Ministry of Electronic Industries (Minelektronprom) and the Ministry Electrotechnical Industry (Minelektrotechprom) which was responsible for component production.

Gostelradio was the State Committee dealing with television and radio broadcasts both in and out of the Soviet Union. It was also referred to as the USSR Ministry of the Radio Industry.

Organizational Structure: Republic Level

Each of the 15 Soviet republics had its own MinSviaz, subordinate to the national MinSviaz and the republic's local Council of Ministers. Fifteen individual MinSviaz administered the facilities in their respective territories.

Each Minsviaz operated on the principle of khozraschet, or internal accountability. Individual enterprises had their own bank account, conducted their own accounting, and were generally financially independent. In 1987, there existed some 7000 financially independent enterprises, 1200 of which lost money in 1987. Minsviaz profits in 1988 totalled 5.3 billion rubles, but 75% was returned to the central government.

The 15 republic networks operated on different standards of equipment with certain networks operating only on a domestic scale. According to law, the Republic governments abided by All-Union standards, and the All-Union ministry was responsible for conducting activities overlapping republic boundaries, but the republican Ministries were fully responsible for the development of the communications networks in their respective republics.

Every Soviet enterprise, large or small, had the right to trade with foreign countries through joint ventures. This right extended to the ministries, both at the All-Union and the republic level. Procurement was handled by the separate republics, but the Ministry of Finance was required to review projects dealing with hard currencies.

Russian Telecommunications Today

In the past, the Russian republic oversaw its own telecom policies, procurement and installation of its telecommunications network within its own boundaries. Russia had its own technical research and development institutes. Today, Russia's control over its telecom system is expanding further as the all-Union governmental structure disintegrates into a body that only exists to coordinate the economic and technological policies of the republics.

In Moscow, local communications are organized by MGTS, which serves 3.8 million local phones through a network of terminal and district PABXs. Inter-district bridges are connected to nine inter-city bridges under Sovtelecom and Moscow through a combination of satellite, microwave and ground cables. Calls are routed within the inter-city network through 12 automatic switches, one for each USSR region.

Special industry networks and/or departmental networks are all connected to the 12 main trunks. Sovtelecom uses 12 main trunks for diverse routing. Trunks exist between the various switches and the Moscow inter-city network. The international switch is Sovtelecom switch number 10 and the Kiev switch operated with AT&T.

Sovtelecom is an All-Union stock company. The Russian Republic holds 72% of the shares, and the remaining 28% is allocated among 25 other long distance companies across the USSR. Seventy percent of Sovtelecom's facilities are in Russia, though the company owns equipment and installations in other republics. Total employment includes 55,000.

When establishing a new project in the Russian Republic, Sovtelecom is subject to a license from the RSFSR Ministry.

An interesting phenomenon in Russia is the specialized networks operated by various ministries other than MinSviaz. For example, the Comincom company has been established to build up and operate separate Digital Overlay Networks in the USSR and has been granted the status of Recognized Private Operating Agency (RPOA) by the International Telecommunications Union. It was formed by the Ministry of Foreign Affairs, Ministry of Communications, the Orbit Bank, and a number of state enterprises.

Its main activities are to provide commercial international telecommunications services to customers and establish and operate international telecommunications centres and local networks to connect customers to them.

The company organizes the export and import of different types of electronic equipment as well as intellectual products. It also provides services in engineering digital telecommunications networks and manufactures different types of communications equipment. The scope of the company activities also spans leasing of local and foreign telecommunications equipment in the USSR and abroad, co-operation, advertising, marketing and training.

Organizational Structure Under the Economic Treaty

In the event that some form of economic union emerges from the shambles of the USSR, some guidance on future collabration on telecoms may be gleaned from the draft Economic Community Treaty. Its usefulness is limited because only eight republics signed the treaty and the principles behind the distribution of authority lack detail, but the balance of power is obviously skewed in favor of the republics. The treaty deems relations between the community and its members to be based upon generally recognized principles and norms of international law. This clause concedes that, indeed, the republics are sovereign nation states.

Any integration of the individual republics is based solely upon the possible economic advantage of coordinating trading, scientific, technological and foreign policies. As the republics switch to a market economy and enter the world economy, members would agree to "bring their economic legislation closer together and conduct coordinated policies in a number of areas." These areas include

scientific and technological programmes of common interest to the community and standardization. It is likely, though not definite, that telecommunications would fall under the realm of such "technological programmes."

The outcome is not merely of theoretical importance. It is at the heart of a basic policy debate within the All-Union structure and the former Soviet republics. All-Union authorities are advocating the evolutionary development of a "Trans-Siberian Line" (formerly the Trans-Soviet Line), which on economic and security grounds would constitute a national "backbone" for an integrated, nationwide communication system linking the two extremes of former Soviet territory. This Line would also enable the Community to capture hard currency earnings by transiting international calls from West Europe to Asia over their own territory and, of necessity, would link the republics with contiguous international networks. The initial building blocks for this network are to be installed in various key localities, Moscow, St. Petersburg and Kiev, where the Soviets have proposed to install international "gateway" switches.

At the same time, various republics and municipalities are in the process of exploring other forms of gateway projects which would establish international connections for the republics in their own right and which could also serve "community" purposes by interconnecting European and Asian USSR, albeit via networks transmitting North America. Moreover, republic authorities, or subdivisions thereof, have indicated the desire to establish their own international and regional gateway switches.

The treaty and the related debate thus raises more issues than it resolves. For example, it does not indicate the recipient of the revenue from an international system, who receives the interest, nor who controls the traffic. If a central agency uses the facilities of the republics then must the "community" government pay the republics rent? Will parallel telecommunications systems of the republican governments and all the all-Union governments compete? The confusion regarding the creation of a Banking Union and the preservation of a single currency adds additional problems. The Community Treaty does not even begin to answer these questions, among others, which will emerge as soon as telecommunications projects are discussed in the national government or in the republics.

On the Cutting Edge: Unilateral Developments Toward Privatization and Currency Reform

Irrespective of what may emerge on a cooperative basis, the various republics, particularly the RSFSR (Russia), have initiated various substantive measures with broad impact on the Republic economy and of particular relevance to telecommunications. These measures include the November 15 edict on foreign exchange and the forthcoming edict on privatization.

With respect to the former, Russia declared itself independent from any external regulation on foreign economic activity and declared its own sovereign mastery over its own foreign economic affairs. As a result, all Russian enterprises are now allowed to engage in foreign economic activities. Such activities were previously subject to strict licensing procedure by the various Central and Republican ministries of foreign economic affairs. Now, licensing of and quotas on import/export operations will be relaxed. Such operations will be taxed, however, at the Republic level.

In order to establish the primacy of Russia currency, on the other hand, foreign exchange settlements of local transactions are prohibited. In the telecommunications sphere, this principal might eliminate the possibility of hard currency settlements by international carriers to local telecos, absent some special, qualifying arrangement for their sharing directly in the foreign exchange revenues generated by international traffic. Such arrangements would be subject to the concomitant principle first mentioned that all enterprises, including local entities, may engage in "foreign" economic activity, including intermediary activity. The status of local telco access and termination of international traffic in this context may require further definition. Obviously, the relevant ministries are obliged to find ways and means to serve the hard currency requirements of local and regional telecos, particularly with respect to the ownership and acquisition of western-source goods and equipment, which are only available on the international market.

The ultimate and long-term solution to such issues is the development of a freely convertible currency. This task is entrusted to the Russian Central Bank. All banks will be authorized to deal in foreign exchange; a market-based foreign exchange convertibility will be allowed; the Central Bank will have a right of intervention; foreign currency accounts may be maintained and used freely by local entities.

An interesting element of the overall policy is that foreign exchange reserves will be developed for the purposes of convertibility through requirements that local enterprises sell to the Russian Central Bank part of their foreign exchange receipts at an exchange rate that may be different from the market rate. Besides tax and duty on imports, this measure will effectively reduce the foreign exchange availability of entities such as local telecos derived from hard currency revenues that they might otherwise earn through settlements on international traffic. At the very least, it will limit the amount of foreign exchange directly under their control and therefore limit their ability to import equipment freely.

On the other hand, local companies will be allowed to purchase foreign exchange for imports, and foreign investors will be allowed to repatriate profits and dividends. Obviously, any joint venture agreement must carefully define the concept of "profits" and "dividends." At the Republic level, such operations, as well as investments by local companies abroad will be subject to licensing. It is fair to assume a chronic deficit of foreign exchange reserves until Russia is able to balance its foreign trade. Hence, there will be limited licensing. The regulations to be developed ultimately may impede the ability of local telecos to proceed to overhaul of their system without a license to import equipment and services. The granting of any such license may be subject to uncertain foreign exchange availability at the Central Bank. The saving grace may be the telecommunications is consistently identified as a priority sector, and therefore may be granted, either formally or informally, special recognition in the context of any licensing regime.

Concerning privatization, the Russian republic has announced that it will issue decrees requiring the ministries to divest their holdings in state companies. It is expected that various state companies will be converted to the joint stock forum, so that shares can be sold or otherwise disposed of on a gradual basis. What is not clear is whether or not such shares will require payment in hard currency, or whether local currency will be acceptable. Consistency with the foreign exchange edict would have the question turn on the nature of the business of the enterprise involved. Obviously, western partners in substantial joint ventures may be under some pressure to "acquire" an interest in their Russian partner through the acquisition of shareholdings. It may yet emerge that the Russian "contribution" to joint ventures may be shares in the constituent enterprise.

A countervailing consideration to western acquisition, would be the position of local management. One of the purposes of privatization would be to turn over operations to a cadre of local managers conversant in the dynamics of the state enterprise. Obviously, such "management buy-outs" would be a principal way of perpetuating incumbent interests.

In the absence of overall direction, local authorities have conducted privatization on an ad hoc basis. In all such cases, however, there is the general problem of evaluating Soviet assets. In addition, some of the largest pending such privatization efforts--principally in the automobile industry--have been hampered by disorganization at the government level. It is not always clear to potential acquirers to whom they should be talking and who even owns the assets in question.

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(2) Craig A. Johnson and Nicholas Stevens, ed., The Soviet Telco Outlook: Background for the Future (Washington, D.C.: Center for Strategic and International Studies, 1991) 6.

BUSINESS TELEVISION IN THE PACIFIC RIM

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This paper presents a brief summary of preliminary findings about satellite networks used for private video broadcasting. Such networks are particularly prevalent in the U.S. and in Japan.

INTRODUCTION

This paper is a summary of some of the preliminary findings from the study *Worldwide Business Television Networks*, undertaken by KJH Communications in late 1990. This multi-client study surveyed private, program, and educational satellite networks around the world. (Networks that have as their major purposes the provision of entertainment and those that serve sports operations were excluded from this study.) Data for private networks that operate in North America and Asia, and specifically in the U.S. and Japan, are summarized in this paper. Private networks are defined as those that are operated by companies, government agencies, or non-profit institutions for purposes of providing information, training, and motivation to employees, franchisees, resellers, and/or customers.

GROWTH IN NUMBERS OF NETWORKS

Our study examined over 250 networks worldwide and found that 127 networks met our criteria for private networks, which included a requirement for having broadcast during 1990 at least six programs to permanently installed downlink sites.

The greatest number of networks (see Figure 1) is found in North America, where the practice of using Ku-band satellite frequencies for private networks first became popular in the early 1980s and where there has been an annual increase in operating networks to the 1990 total of 68 networks. All but one of these North American networks operate from the United States. The second largest number of networks is found in Asia, where all but two of the 45 Asian networks operate in Japan.

A look at the numbers of operating networks year by year shows interesting growth patterns (Figure 2). Observers of the market in the United States were extremely optimistic in the mid and late 1980s about the continued adoption of business television networks, and indeed the growth patterns were strong through 1989. The picture began to change in 1990, however. For a variety of reasons, including the slowdown of the U.S. economy, fewer new networks were established and several existing networks ceased operation, resulting in a decrease in the growth rate. The resulting growth curve resembles not the "hockey stick" effect predicted in 1988 but the beginnings of a more classical "S" curve of innovation adoption.

The rapid deployment of networks in Japan since the launch of JC-Sat in 1989 shows a sustained rate of growth in numbers of networks through the end of 1990, even in the face of the failures of the two Superbird satellites. The question for forecasters is whether this rate of growth in operational networks will be sustained, given the beginning of a slowdown in the Japanese economy and the possibility that some existing networks, having tried business television, may decide against continuing.

DOWNLINK SITES

The 127 business television networks worldwide account for over 40,000 downlinks (Figure 3), including TVROs that are designed solely to receive video programming and VSAT downlinks that transmit and/or receive data as well as receive video programming.

The 30,000 downlinks associated with the North American networks and the 12,000 downlinks in Asia yield average network sizes of approximately 270 and 440 sites for North America and Asia, respectively. The larger average size of the North American networks reflects the presence of several VSAT data/video networks with several thousands of sites in the United States, primarily in the automobile manufacturing and retail industry segments. In Asia, the business television average network size is not yet influenced by large VSAT data/video networks.

INDUSTRY SEGMENTS

Worldwide private networks represent a number of industry groups (Figure 4). Manufacturing companies account for the greatest number of networks in both North America and in Asia. The largest numbers of networks are found in the office equipment and electronics industries, where networks are used for disseminating product information to internal and external

audiences, including customers, and for training employees of the manufacturers and their dealers. In the automotive industry, networks provide a variety of information to employees of manufacturers and their dealers.

Financial services companies account for the second largest number of networks in both North America and in Asia. In this industry group, insurance companies and non-bank financial services providers (securities and investment firms) are most represented. With one exception, banks are not users of business television networks, primarily because of the political boundaries within which they operate.

With few major exceptions, industry groups represented by private business television networks in the United States and Japan are essentially the same. One exception is the presence of business television in the construction industry in Japan.

TRANSPONDER USAGE

The method for procuring satellite time and the annual usage varies greatly, depending on the applications for the network (see discussion below). The majority of users book transponder time on an occasional basis; however, those with regular program schedules or extensive programming rely on part-time or full-period transponder leases. A sampling of approximately 30 percent of the Japanese networks yields an average annual usage of approximately 300 hours for 1991; usage on the U.S. networks, based on a 90 percent sampling rate, is approximately 470 hours.

Coverage is almost always domestic only. There is little use of international satellites to distribute business television programming between Asia and North America, primarily because of the vast differences in time zones and the additional cost to reach relatively smaller audiences.

APPLICATIONS AND BENEFITS

Most applications of private business television networks can generally be classified as corporate communications, product information, and skills training. In addition to these major categories, there are many unique applications for satellite-delivered private network programming.

Corporate Communications

In Japan, company chairmen use their networks for new year's greetings. Other annual corporate communications programs include year-end financial and business summaries and statements of directions for the new year. Similar programs, including sales "kick-off" meetings, where sales targets and strategies are revealed, are common annual events in the United States. And the death of a founder or senior officer in either country is usually covered on the network.

Corporate news programs are common in the United States and Japan. These programs range from 5-minute daily news programs based on the previous day's business and financial events to longer magazine-format programs that include segments designed more for motivation and fostering company spirit than to satisfy need-to-know requirements. While many networks begin by using professional anchors to host these programs, many find that employees of the corporate communications department, though not as polished in performing on the air, contribute more credibility to the broadcast.

Companies in both countries use their networks for a variety of management communications. Where scrambling equipment is employed, regional messages can be targeted to appropriate downlink locations.

The chief advantage of satellite networks over other delivery vehicles for corporate communications is the ability to inform large numbers of people simultaneously. In order for communications to be perceived as credible and significant, networks must apply certain journalistic standards to programming that is featured as news or commentary, and networks must guard against trivial and overly long productions in all programs.

Product Information

The dissemination of product information occupies the largest amount of broadcasting time on the private networks. Programs deliver marketing information to internal sales staff or dealer personnel as well as technical information to technical support personnel, service technicians, and customers. In some instances, broadcasts are aired without scrambling in order to provide video information that can be used on public or commercial television stations.

The chief advantage of satellite networks for disseminating product information is the ability to shorten the cycle time for informing a field force. When a new product or product feature becomes available, information can be communicated directly to the individual in the field without the need to send it through layers of management in the field organization. This time advantage may cause concerns among middle management personnel in traditional bureaucracies, who may perceive the network as diminishing their responsibilities and stature in the organization.

A major challenge for almost all networks is the control of program content. Product managers, who are often the "clients" for product information types of programming, often need help in translating face-to-face

presentations into formats suitable for the television medium. Targeting specific audiences, choosing a limited amount of critical information to be conveyed, and generally limiting the length of these programs are the biggest challenges to network managers.

Skills Training

In this study, we use a strict definition of skills training to mean instructional programs where objectives are clearly defined and there is some change in behavior desired from the viewer. We differentiate this type of programming from the mere dissemination of information. Many companies do provide their audiences with well-designed training delivered over their networks. Interaction during the training program may be carried via telephone, facsimile, a still or motion return video link, or data response units that employ a keypad for polling, testing, and otherwise obtaining feedback from participants.

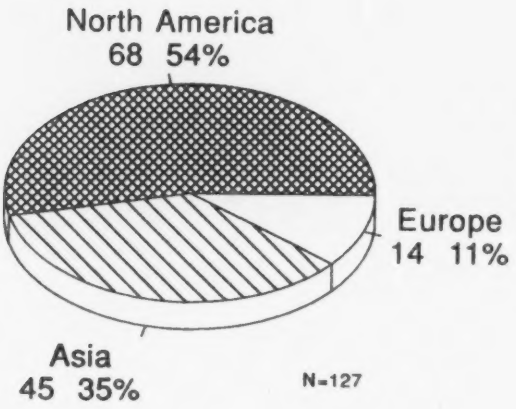
The chief benefits to using business television networks for training are cost savings from less travel, the ability to train more people using the same training resources, and the reduced amount of time that salespeople spend away from their customers and their sales territories. The greatest challenges for companies using satellite networks for training are in developing courses that are sufficiently rich in activities and information so that the audience can develop skills in a comfortable training environment. Well-run training programs often combine local activities with satellite-delivered activities and make use of a mix of delivery vehicles including instructional hardware and local facilitators at each site.

SUMMARY

This brief paper presents only a small portion of the study data, but enough to see that satellite networks have been embraced by a number of companies in North America and Asia, and particularly in the U.S. and Japan, with various requirements for communicating to dispersed employees, dealers, customers, and other audiences.

Figure 1

Distribution by Region
1991 Private Networks



©KJH Communications

Figure 2

Distribution of Networks by Year
Private Networks

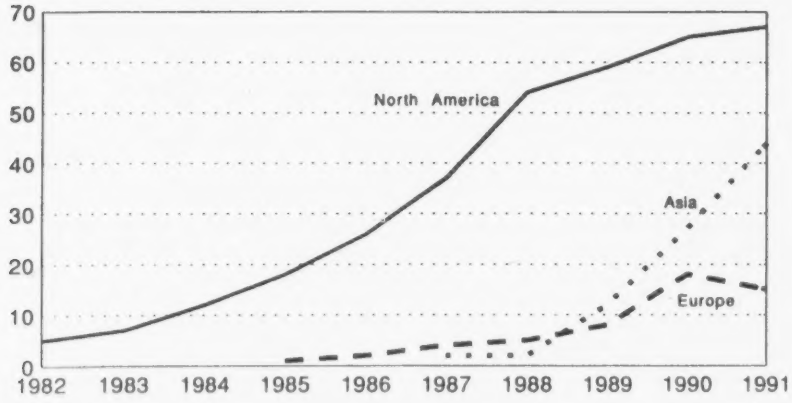


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Figure 3

Distribution of Downlink Sties by Year
Private Networks

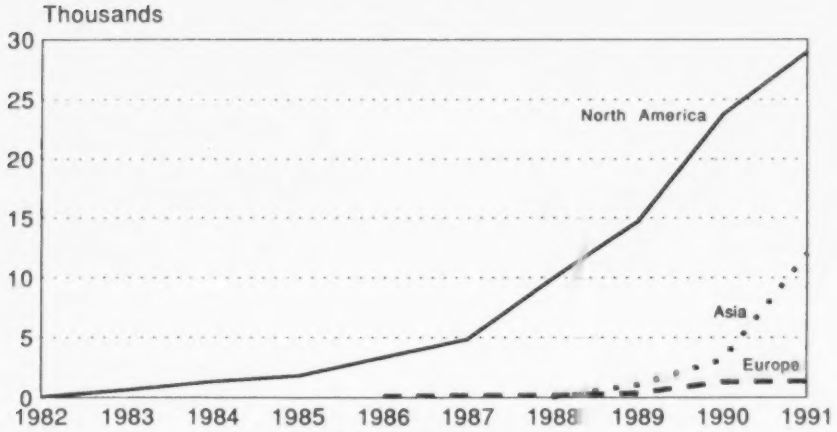
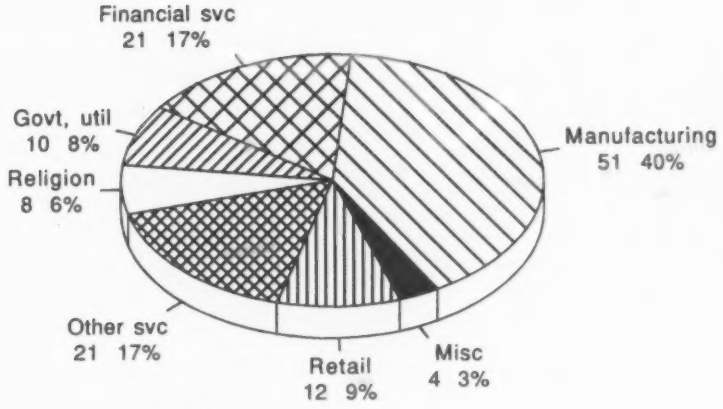


Figure 4

Distribution of Networks by Industry Group
1991 Private Networks Worldwide



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"The Evolution of Voice Processing -- Integration of Voice and Data as a Strategic Advantage for Pacific Rim Companies Operating in a Global Market."

By Mr. Jan Waluk
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The Pacific Rim is emerging as a major market in the global economy. At this critical point, when a region is one of the fastest growing in the world, it is crucial that information access be timely and accurate. With the recent trend in the telecommunications industry where two technologies, voice and data, have been integrated, voice processing has become an effective way to communicate at any time and from any place in the world.

The sun is rising on a new industry, voice information processing. This paper will address economic and technology trends that have paved the way for sophisticated transnational communications. On a more direct level, it will explore the emergence of voice information processing; the benefits of the technology; its growing presence in the Pacific Rim; and finally, how it translates to maximum productivity and reduced costs for companies operating on a global scale.

Voice information processing, the marriage of voice and data processing technologies, is allowing multinational companies in the Pacific Rim (Pac Rim) to conduct business with a global handshake. It is estimated that trade between North America and other Pacific Rim countries was worth $US15 billion in 1970, growing to $US215 billion today, and could rise to $US750 billion by the end of the decade (1). With this unprecedented trade activity, communication technology has met its challenge.

"Globalization" has been more than a trend and a fascination, it is the hallmark of the twentieth century, and nothing has accelerated the momentum of globalization quite like the telephone, which has been dubbed the ubiquitous terminal. If information is a company's most strategic asset, then the ability to mobilize it efficiently and expediently through voice and data technology will be a company's highest strategic advantage.

Voice information processing technology -- the means to link voice-, text- and image-based information over international telephone networks -- is becoming the preferred global business connection. Not only does it provide a seamless interface among computer databases, fax machines and voice mail boxes, but it also bridges the time and distance gap. Users can access time-sensitive information or deliver important messages at any time from anywhere in the world, in a single telephone call.

Growth in the Pacific Rim

A confluence of trends are contributing to the explosive growth in the Pacific Rim. The export-driven growth of the 1980s has created a higher standard of living and there is a surge in the demand for consumer goods: TVs in Malaysia, cars in Indonesia, telephones all over the region. At the same time, the labor costs and manufacturing sophistication in the region have created a new land of opportunity and high profits that the whole world would like to tap.

As a spokesman from Texas Instruments (one of the largest corporate investors in Asia) pointed out, "If you're going to be a player in the '90s, you've got to be in Asia" (2).

As the Pac Rim grows into its position as the number two supplier of products worldwide, supplanting Europe, global highways carrying vital information on technology, vendors, suppliers, customers and market conditions, need to accommodate the intensified information traffic.

Pac Rim Tigers

The four "tigers" or "dragons," Hong Kong, Singapore, Taiwan, and South Korea, have shown exceptional manufacturing strength with active capital and financial markets.

Hong Kong, for example, a long-time free-enterprise and free-trade economy has earned its international reputation as a leading manufacturing and commercial center. Because of its favorable economic climate, productive work force and strategic position in the Pacific Rim, Hong Kong has garnered foreign capital, mainly from the U.S., Japan and the United Kingdom. Hong Kong will continue to be a vital center of communications for the Pac Rim community.

Japan warrants little introduction to the Pacific Rim forum. With a gross national product pushing 400 trillion yen with total exports nearing $US300 billion (3), Japan is a vital force, worldwide, not only in the Pac Rim.

Developing and developed countries alike, realize that an advanced communications infrastructure is a prerequisite for attracting new business investment. Thailand and Malaysia, witnessing the success of the four dragons, are adopting technology that will invigorate their economies. Thailand envisions the addition of 3 million new telephone lines, while Malaysia's current telephone density of 8 percent is expected to climb to 25 percent by the end of the '90s.

Australia, whose exports have grown manifold, has become a popular world trade partner. To support the surge in world trade, Australia is developing a regional telephone network that will expand from its current 37 million telephone lines to some 325 million over the next 50 years (4).

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Expanding Transnational Communications

To sustain the increasing economic activity in the Pacific Rim, the availability of advanced communications technology will need to expand at an even faster rate than investment and exports. And there is an aggressive response from telecommunications companies on the other side of the Pacific (the U.S.) to capitalize on the emerging Pacific Rim telecommunications market.

Just as barriers are breaking down to create a contiguous global marketplace, barriers to competition in telecommunications are also falling. Deregulation and privatization of national telecommunications companies especially in the Pac Rim, are creating an intense competitive climate. New telecommunications companies moving in from abroad are pressured to provide global solutions to their corporate customers who have gone "global." As a result, a vast intercontinental infrastructure for both fixed and mobile transmission is in the making, and partnerships are being formed to lay transoceanic voice and data cable systems.

A recently announced Asian fiber optic cable will be owned by some 38 carriers to link Singapore with Japan, via Malaysia, Hong Kong and Taiwan. California is also a major economic power in the Pacific Rim (some say the sixth strongest in the world), and technology to increase transmission speed among California, Australia, New Zealand and Japan will soon be in place.

At the Pacific Rim Futures Conference (September 1991), an officer said, "It cannot be overemphasized: telecommunications and technological changes have caused and will continue to cause more globalization, greater interdependence, instantaneous informational flows, immediate recognition of financial risks and opportunities..."

As an indicator of heightened business activity between countries, international corporate voice, data and teleconferencing (measured in messages per minute) is growing at an annual rate of 15 percent to 20 percent, nearly double the 7 percent to 9 percent corporate domestic rate, according to Arthur D. Little (Cambridge, MA).

A sampling of the 10 top countries the U.S. talks with the most includes three Pac Rim countries: Japan, South Korea, and the Philippines. Telephone calls in millions of minutes from the U.S. in 1990 were 214, 164 and 163, respectively (5). With the proliferation of voice information processing and the ability to access multiple information sources across nations and continents, the frequency is sure to be on the rise; meanwhile, the demographic representation may change as the Pacific Rim captures more of the top 10 spots.

Voice Information Processing for Cellular Users

In addition, the cellular industry is moving toward offering a more comprehensive suite of integrated voice, data and image applications. In 1990, the Asia/Pacific Rim countries accounted for 15 percent of the world's cellular subscriber base, or 1.6 million. Within the region, Japan will be driving the growth accounting for nearly half the customer base by 1995 (according to EMCI Inc.). In the streets of Tokyo, for example, it is not uncommon to see mobile phones in the hands of ambitious people, who can't afford to miss a beat -- whether it's stock prices on the Tokyo Stock Exchange or a promising sales lead.

Cellular providers have been quick to answer customer needs and to seize new marketing avenues with enhanced information services. Meanwhile, those who are serious about closing the communications gap through cellular phones are just as serious about the services voice information processing can provide. For example, mobile callers can retrieve messages from voice mail, instantly access audiotex services for updates on key corporate or financial news, and leave a detailed message with a business associate that needs to respond immediately to the news.

Where timely information means the difference between success or failure, mobile communications coupled with voice information processing allows users to hedge the risk of missing important news.

Voice Information Processing: Emerging Technologies

Traditional voice mail involved little more than the use of computers to electronically store voice messages for later retrieval. In time, more advanced voice mail capabilities, such as automated call routing and distribution, voice-prompted forms registration and voice bulletin boards, emerged. Today's voice information processing offerings include a range of voice, data and image technologies that can be integrated into one phone session; they include:

Interactive Voice Response -- The ability to input and retrieve information from a computer database via touch-tone telephone. Provided that 80 percent of all U.S. telephones and a growing percentage of international telephones feature touch-tone dialing, banks, universities, and newspapers, to name a few, are automating customer service with voice information processing. The benefits are improved responsiveness and a better allocation of resources.

Fax Publishing (Fax-On-Demand) -- The ability to request that fax information be automatically forwarded to the caller via touch-tone phone. With fax publishing, companies can disseminate current information -- from price lists and product brochures to contracts and healthcare benefits -- to their customers, clients, contractors and employees. In this way, postage costs and long distance telephone costs can be reduced, while information can be expediently delivered.

Audiotex Access -- The ability to access timely news residing on computers via satellite feeds to the telephone. Many companies are generating new revenue by offering audiotex services -- from newspapers which offer audiotex-based news updates to financial companies which provide up-to-the-minute access to breaking news and stock market reports.

Two-Way Message Notification -- The ability to link voice mail and electronic mail systems so that users can collect all messages -- voice- and text-based -- through a single source. This capability encourages better communication and decreases the time and costs associated with accessing different, incompatible systems.

Voice Recognition Response -- The ability for people to interact with computers by speaking commands into their telephones. This development is a natural interface for applications such as order placing and sales reporting. In the not so distant future, voice recognition technology will be able to read computer-based E-mail messages to users who call in from remote sites.

Applications Mix

Designed for customization, voice information processing allows customers to pick and choose from a variety of different applications. Given the flexibility of modular systems, management can choose the appropriate mix of voice and data modules to fit current needs and expand applications and systems as the company expands.

Evolution of Integrated Solutions

Over the past two years, E-mail, voice mail, fax, cellular phones, audiotex and interactive voice response have improved information access and responsiveness. Until recently, these technologies did not provide complete solutions because they were stand-alone, not integrated solutions. For example, when faced with stand-alone solutions, an employee traveling overseas -- who wants to connect with the home office -- calls one number to retrieve messages from voice mail, then logs-on to a computer to inquire about electronic messages, and then calls a third number to inquire about faxes. Today's integrated solutions offer the same traveling employee convenient access to messages, E-mail and fax in a single phone call. The advantages of integrated solutions become more significant when companies are calling overseas, because time saved translates to even greater savings in long distance rates.

The Benefits of Voice Information Processing

In the age of lean corporations and fierce competition, voice information processing technology can help companies reduce labor costs by automating tedious telephone answering and basic message response. It can free-up staff for more important and productive tasks. It can increase accuracy and efficiency by eliminating message errors and by automatically forwarding messages to groups of people for more immediate action. It can augment security by enabling fax and/or messages to be sent to private mail boxes rather than a public fax. It can provide access to more information sources via computer databases and satellite services, and the list continues.

With respect to labor savings, studies suggest that the use of voice messaging alone will save a company on average, a half an hour per person per day (6). Voice messaging lessens the chance that a message will be lost or misinterpreted, and it eliminates frustrating telephone tag!

Enhancing A New Management Style

Fundamentally, this new technology can boost employee involvement and awareness through open communications at all levels -- peers, superiors and subordinates -- leading to higher worker output and satisfaction. This decentralized corporate communication characteristic of the Japanese style of management, has been successfully imitated by the U.S. and others. Though hierarchical, it is also participative, and western business cultures have begun to notice the positive repercussions on the way people interact, create, and execute tasks, not to mention improvements to productivity and a company's bottom line.

Because voice information processing brings together people from different levels and locations with decision-critical information, it will play a key role in optimizing the benefits of the decentralized management structure. For example, a project leader can easily send out a single, standard message to a programmed set of individuals, relaying project completion dates, special policies, or even feedback. This serves to reinforce project completion and proves a necessity when the project team is divided between the Pacific Rim and the U.S.

For instance, sales people can pass on customer requests for new products/services to management. At the same time, these messages can be simultaneously passed on to customer support and product development at corporate headquarters in another city, state or country. By involving management, product development, customer support and sales at the onset, better solutions are apt to be found more quickly.

Acceptance of Voice Information Processing

Implied in the technological impact of voice and data technology is the sociological impact, which may greatly reshape the way organizations function and the extent to which people use the telephone to their utmost advantage. The acceptance level of voice processing is high, and the same is expected for voice information processing. The reasons are simple: for most of us, the phone is a natural extension of the way we communicate, and the operation of its keypad couldn't be made easier; it has been around for most of the 20th century; and it has played a major role in our personal and professional development.

In contrast to the personal computer that becomes intuitive once commands are learned, voice information processing provides a voice-based instructional interface that guides a user by providing options. With voice information processing, commands need not be learned, and users can discover a number of innovative ways to communicate across distances.

The Markets Served

Among the major markets for voice information processing are banking and finance in such applications as account inquiry and transactions; insurance for coverage verification and premium quotes; transportation for scheduling and shipment tracing; manufacturing for inventory and product cycle communication; and the service industry for mail order and credit card requests.

Other markets include healthcare to streamline communication among medical professionals; colleges and universities for registration, campus events publicity and ticket orders, career information, and increased professor/student communications; state and local governments for increased responsiveness to public concerns and coordination among the different government agencies; and publishing for classified advertising, opinion polls and information bulletins.

What a Difference a Day Makes...

In the context of international business and communications, 24-hour access to information is imperative because a business associate in one part of the

world may be leaving work when others are starting their workday. Although voice information processing technology can't eliminate time zones, it allows business counterparts to carry on projects that might otherwise have to wait 12 even 16 hours depending on geographic locations.

The fax machine has done much to bridge the information flow given time changes and multinational operations. Voice information processing will take international businesses another step in providing continuity between groups working in tandem from different parts of the globe. The productivity leaps are already impressive, and the technology is still in its early stage.

Case Histories

As an example of bridging time-zones through voice information processing, McDonald's, which has become an international icon, has set up a network of Octel voice mail boxes to foster communications among offices in the U.S. and Australia.

With the communications hub in Chicago, offices in Sydney Australia (12 hours ahead) can program their messages so to be sent at 10:00 p.m. Australia time for early morning pick-up by their U.S. counterparts. In this manner, there is a more continuous information flow, and McDonald's can save money by transmitting messages during off-peak times.

With a carefully constructed database, general information pertaining to McDonald's facilities, construction, equipment and marketing, can be immediately channeled to various destinations as far down under as Sydney and Melbourne. Senior executives at McDonald's also use the systems to broadcast new environmental policies or send press releases to the regional managers -- a form of internal public relations.

Beyond bridging time-zones, Celcom Malaysia is an example of targeting technology to cultures and languages. Celcom Malaysia, operator of Malaysia's latest mobile communications network, ART 900, installed Octel's voice messaging and interactive voice response applications to meet the rising demands for more extensive mobile or remote communications services in that country and around the Pacific Rim.

Celcom Malaysia will offer multi-lingual prompts in Malay, Cantonese and Mandarin in addition to English to guide users through the applications. The first installation of its kind, Celcom Malaysia will initially focus on integrating Hong Kong and Taiwan into the network and subsequently expand communications into other countries in the Pacific Rim.

Publishing is a strong market for voice information processing because it is by nature a gatherer and purveyor of information. Telephone answering, voice messaging, voice bulletins and audiotex information allow publishing businesses to save money and free-up people for more interesting tasks, while providing a higher level of service to their readership and advertisers.

Singapore Press Holdings, which has the largest daily newspaper in Singapore, found that adding voice information processing was a move "to stay on the forefront," as the publishing industry changes. For Singapore Press Holdings, this technology is more than a round-the-clock advertising tool, it is an up-to-the-minute information provider as well. Classified advertisers can have inquiries left in a personal mail box so they aren't disturbed at home. Users can call in for weather bulletins, tide and flood information. There are also lines for sports and financial news. Editors can also poll their respective communities on political events and controversial issues.

Because of the multitude of tasks that can now be performed with voice information processing, and its impact on productivity as we operate more on an international scale, this technology may eventually be thought of much as the telephone itself: one can't imagine existing without it.

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AN UPDATE OF OFF-THE-BEATEN-TRACK DIGITAL NETWORKS;

A CASE STUDY FROM INDONESIA

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During the first two years of this decade, the International Satellite Telecommunications regulatory environments experienced dramatic changes. With advances in earth station technology imminent, these changes will rapidly lead to the redefinition of International Networks.

This paper illustrates this redefinition through a case-study of a Texas-based multinational corporation. Their Indonesian operation consists of a regional office in Jakarta which supports several isolated exploration and production sites.

The Texas-based organization's objective, shared by its numerous counterparts, is to effect reliable communications with its international operations.

INTRODUCTION

Multinational Resource Development Corporations (RDC's) are second only to the U.S. Military in their pioneering efforts to push the latest Telecommunications technologies to the extreme limits of their performance.

An example of their early influence is the widespread use of HF Radio transmission to provide interconnected - telephone and telex communications to remote regions. Because RDCs had both a need for this capability, and the budget to pay for it, they enabled the Telecommunications Industry to develop and commercialize HF Radio Technology. Now commercial automated HF Radiotelephone service is available to fixed, mobile, and marine users, worldwide.

RDCs also pioneered the early development of automated VHF Radio-telephone technologies. Out of necessity they implemented this service wherever possible, and extended it into remote areas of North America during the early '70's.

This early development made North American communications firms world leaders in radio network technology. Corporations such as Motorola developed a wide range of sophisticated radio network advances, including Trunked-Radio, Paging, and Cellular Telephone.

RDCs were also among the first to adopt Inmarsat's L-Band Global Satellite telephone service and, as high volume users, helped to drive its commercialization to its practical extremes.

It is no surprise, then, that the recent global expansion of North American private voice/data networks again finds RDCs in the forefront. Their missionary-style role continues in their use of domestic satellites for private network services in developing nations.

In Indonesia, Mobile Oil pioneered the use of the Palapa Satellite System for private network service in 1988. Shortly afterwards, in Ecuador, Unocal followed suit, using PAN-AM SAT. What had previously been thought unviable due to technical and regulatory factors, the use of domestic satellites for private network services has evolved rapidly in developing nations, fuelled by the involvement of RDCs!

As they influenced Radiotelephone commercialization, RDCs have helped pave the way for other industry sectors in these developing nations to expand their voice/data networks. Less than four years after Mobile Oil's benchmark, several dozen private networks have been installed in Southeast Asia and Latin America. Using Palapa, PAN-AM SAT, and Asiasat, industry sectors in Transportation, Finance, Hospitality, Retail Distribution, and other areas, now operate private domestic satellite networks.

Lacking terrestrial alternatives, they have adopted domestic satellite as the most cost-effective means of providing reliable communication between operations dispersed within a developing

nation. In only a few days, any remote operation's contact with the regional office is transformed from sporadic speech over HF Radio, to fully integrated telephone/facsimile/data service using digital transmission, via domestic satellite.

In fact some of these private networks are providing remote operations with a grade of service equal to, or superior than, that available to their North American counterparts! This sudden abundance of information has allowed the management of these remote regions to make use of greater external input to aid in their decision making.

Unfortunately the implementation of state-of-the-art digital communications between domestic operations in a developing nation has limited benefits without complimentary access to international services. Regulatory and technical barriers limit the implementation of private international satellite networks, and overcoming this obstacle has become the latest challenge to global expansion.

Again it is the RDC's, with their long history as users of private domestic networks, who are pioneering access to international services.

The RDC that will likely be the first to succeed in overcoming these obstacles in its attempt to extend its international network to include Houston, Jakarta, and beyond - is the subject of the case study which follows.

CASE STUDY

OVERVIEW

This study describes the experiences of a Houston based multinational corporation with decades of experience in petroleum exploration in remote locations, worldwide. It currently has a regional office in Jakarta, with several remote operations throughout Indonesia.

Over the past 3 years this RDC has been installing a private domestic satellite network to provide communication between the Jakarta Office and Remote Sites. Digital transmission enables simultaneous voice, data, and facsimile service over this network.

Communication between the Jakarta and Houston Offices, however, depends on the local and international PSTN's (Public Switched Telephone Network). Analog transmission permits substandard voice, inconsistent facsimile, and unreliable data service.

OPERATIONAL OBJECTIVES

Houston-Jakarta Communications:

Over the past five years, this RDC's management has gravitated towards the Houston-based Corporate Information Services Network (CISN) (see Sheet Six) as a primary communications media. With the CISN's capabilities growing steadily and now able to support Voice-Mail, E-Mail, LANs, etc, the importance of having regional offices "on-line" is also increasing.

For the Jakarta operation, this means reliable voice, data, and facsimile communications with Houston, as shown in Sheet One.
Ultimately, the Jakarta Office will act as an international node on the RDC's private network. As shown in Sheet 8, this requires that the following communication interface with Houston:

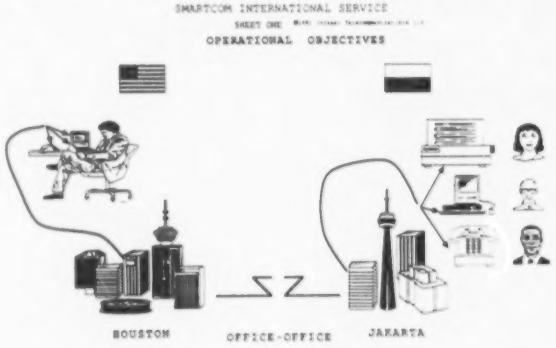
-support of a small Local Area Network
-local PSTN interconnection
-Group III facsimile service
-direct-dial voice service
-local PSTN modem access

Houston/Jakarta-Remote Site Communications:

Confronted with rising remote site daily operating costs, lower production yields, and fluctuating market prices, RDCs must manage international exploration and production activities more efficiently.

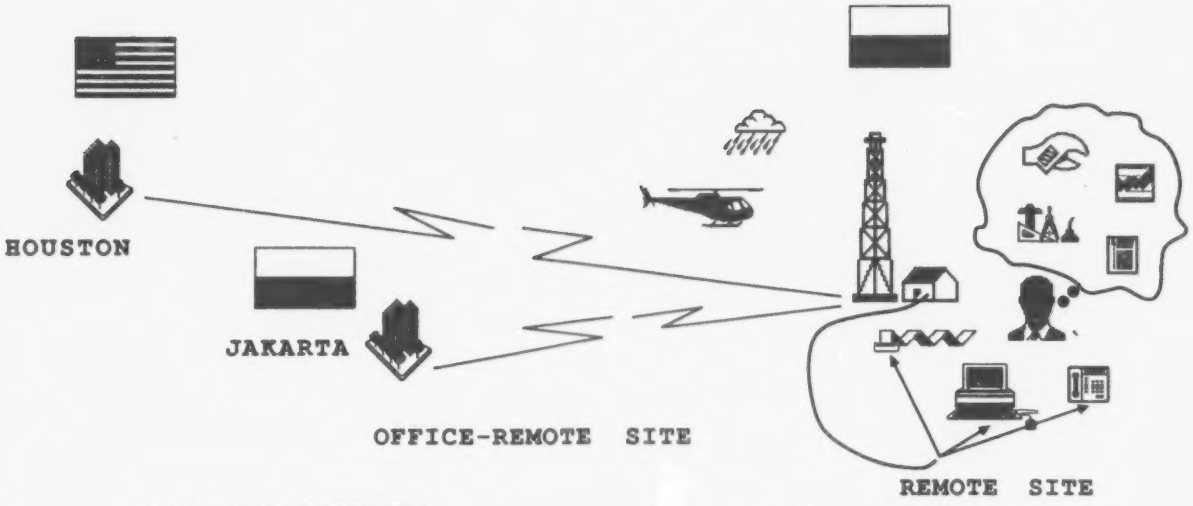
In this case, major efficiency improvements in remote site operations are identified through access to both the Jakarta Office and Houston's CISN. (See Sheet Two)

Reliable voice, facsimile, and data communications will facilitate Houston's technical and operational support on an as-needed basis, reducing remote site downtime. (See Sheet Nine)



SHEET TWO ©1991 Infosat Telecommunications Ltd.

OPERATIONAL OBJECTIVES



LOGISTICAL CHALLENGES

Houston-Jakarta Communications:

A wide range of Houston-Jakarta communication services, readily available from Submarine Cable and International Satellite, cannot be implemented due to the "Last Mile Problem". (see Sheet Three)

The ownership, operation, and maintenance of Indonesia's (not unlike USA's) wired telecommunications network resides solely with the state-owned PTT.

Saddled with the same dilemma that is faced by many other developing nations, that of trying to meet an enormous demand for POTS (Plain Old Telephone Service), the mandate of Indonesia's PTT focuses on basic subscriber services.

In Jakarta alone, the next decade will see the installation of 1,000,000+ basic subscriber lines. This will result in a ten-fold increase in the number of telephones per person. Nearing 1 line for 20 people by the year 2000, Jakarta's penetration will still fall far short of North America's present 1 for 2 level of service.

With Indonesia's PTT committed to at least one decade of continuous expansion and transition, cabled connection to international gateways will remain a significant challenge to reliable network services.

Houston/Jakarta-Remote Site Communications:

Jakarta-Remote communication has relied mainly on HF Radio due to (a) the lack of existing telephone service in many regions, and
(b) the large geographic area managed by the Jakarta Office. HF Radio, at best, is useful for restricted "push-to-talk" voice communication, but remote access to network services such as Telephone Voice, Facs, and E-Mail has proven to be impractical using this technology.

The recent advent of private domestic satellite networks has given remote sites direct access to the Jakarta Office's communication services. However, when the telephone traffic in and out of each remote station is switched through the Jakarta Office, the result in a significant increase in demand for (and decrease in availability of) local (Jakarta) PSTN lines. Having only 3 voice (+1 Facs) lines, (often reduced to 2 or 1 due to service outages) the Jakarta Office Telephone Switch is overloaded with local calls from 8am to 10pm (6pm-8am Houston time).

This means that for 14 hours out of every day, Houston-Remote communication is not available. The lack of reliable facs or data (due to Jakarta's PSTN) makes voice the prime means of communication between these points. So late-night telephone sessions with Houston are held, but only during critical circumstances.

OPERATIONAL OVERVIEW

Houston-Jakarta Communication:

In order to resolve the Jakarta Office's communications bottle-neck, the RDC asked for permission from Indonesia's International Signatory to operate a dedicated Jakarta-Houston satellite circuit. Ultimately seeking the on-site installation of the Jakarta Office's private international satellite station, the RDC knowingly faces an administrative process that will take some time to complete.

This digital international satellite circuit, operating at 64 Kbps, gives the Jakarta Office direct access to the Houston Office. (see Sheet Five)

Equipped with PCSI Voice/Data Multiplexers, the HOU-JKT circuit can be configured to carry 0 to 8 voice channels and/or 0 to 8 data channels operating up to 64 Kbps. (see Sheet Six for Houston's requirements)

The PCSI units are configured automatically according to a pre-programmed schedule that reflects international traffic patterns. A typical program entails re-allocation of circuit capacity on a daily routine as follows:

Sample PCSI Programming
64 Kbps (HOU-JKT)

Slot #:	Jakarta Time:	Circuit Configuration:
1	6am-1pm	28.8 Kbps data for LAN connection 38.4 Kbps for voice: 2@15KBps for Houston-Remote (2-Hop) 1@8.4KBps for Houston-JKT
2	1pm-9pm	56 Kbps data for LAN, etc 1@8KBps voice for voice-mail, etc
3	9pm-1am	9.6 Kbps data for LAN, etc 3@15KBps voice for Houston-Remote (2-Hop) 1@9.4KBps voice for Houston-JKT
4	1am-6am	56 KBps data for LAN, etc 1@8KBps voice for voice-mail, etc

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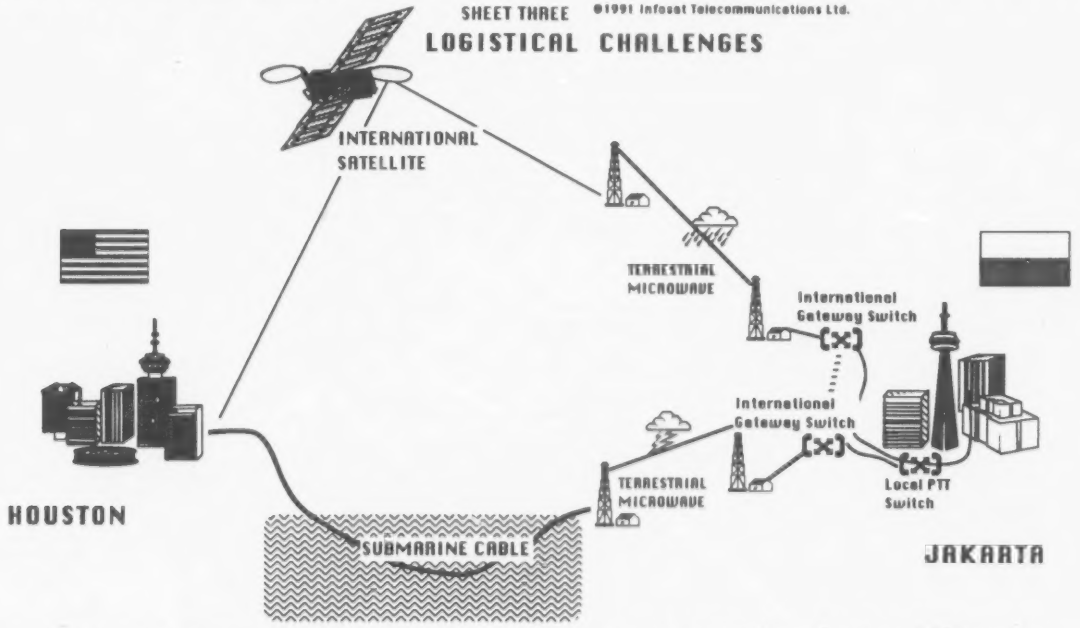
LOGISTICAL CHALLENGES



In this example, the two PCSI units connected to the 64KBps HOU-JKT circuit are programmed for four time slots.

SLOT #1; PROGRAM RATIONALE

During Slot #1, the PCSI units apportion the 64 KBps circuit for 28.8KBps data and 38.4KBps voice.

Remote LAN Interconnection:

For discussion purposes, assume that the entire data capacity is dedicated to linking the Houston (see Sheet Six) and Jakarta (see Sheet Eight) LANs. Operating at 28.8 KBps, the HOU-JKT LAN link supports the small number of users in the Jakarta Office, and at remote sites.

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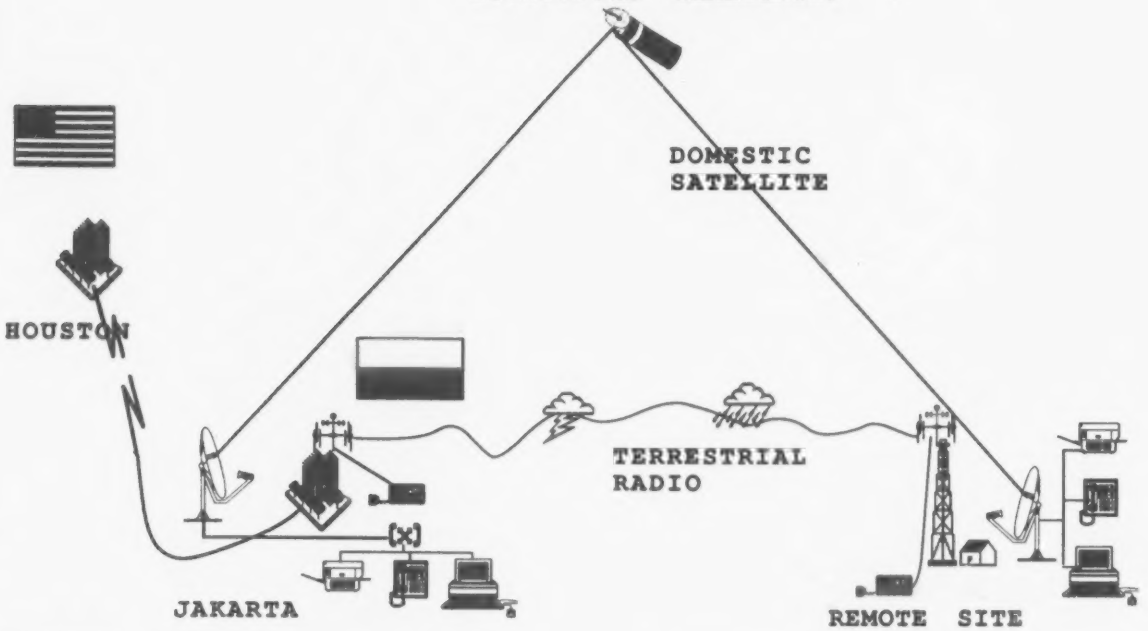
LOGISTICAL CHALLENGES



The PCSI units, using menu-driven software commands, may be manually configured for any data rate from either Houston or Jakarta Offices.

PCSI voice ports are individually configured, under software control, for data rates from 6KBps to 32KBps. Ports operating at >14KBps exhibit outstanding voice quality and are best suited for applications involving two satellite hops (as shown on Sheet Five which depicts the Houston-Remote Site communications path.)

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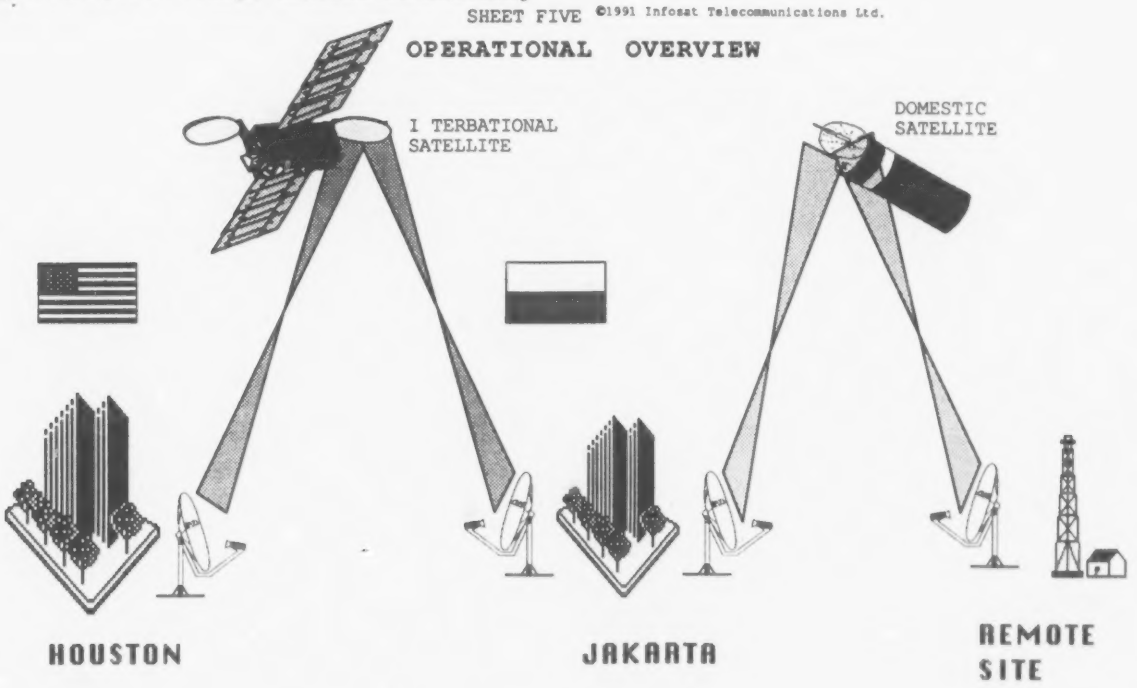
OPERATIONAL OVERVIEW



High Quality Speech:

In order to minimize speech-quality degradation due to compounded voice compression, two 15KBps PCSI voice ports are allocated for HOU-Remote Site calls. This ensures that 2-Hop satellite voice demonstrates no noticeable quality degradation compared with terrestrial voice.

In most cases, where calls are made from within the Houston Office to a remote site, there is no PSTN interconnection. Unencumbered by the uncertainties arising from PSTN interconnection, the PCSI units, configured for operation as if in a closed system, perform minimal signal processing of transmitted speech. This ensures that 2-Hop satellite voice does not exhibit noticeable processing artifacts such as centre-clipping, echo, background noise, etc.

The PCSI voice ports support standard 4-wire telephone interfacing, (see Sheet Eleven) thereby eliminating the need for 4/2 wire conversion at the Jakarta and Houston switches. This minimizes speech quality degradations due to echo and poor transmission level settings.(3)

For remote-site calls made from within the Houston Office, the speech quality, in terms of levels, noise, echo, and centre-clipping is comparable with domestic PSTN fibre. Given this excellent voice circuit performance, callers quickly adjust to satellite transmission delay.

For remote-site calls made from the US PSTN (see Sheet Twelve), the degradation in speech quality may range from unnoticeable to barely acceptable. The degree of deterioration depends on the consistency of Houston Office and Subscriber Line interconnections to the US PSTN or other VNETs (see Sheet Seven).

Digital Connection to US PSTN:

The Houston Office uses a digital interface for connection to the local PSTN Central Office (C.O.). For PSTN calls, the Houston Office Switch creates a 4-wire digital path between the PCSI unit and the local C.O..

The use of the digital (as opposed to traditional analog) C.O. interface ensures the consistency of Houston

SHEET SIX

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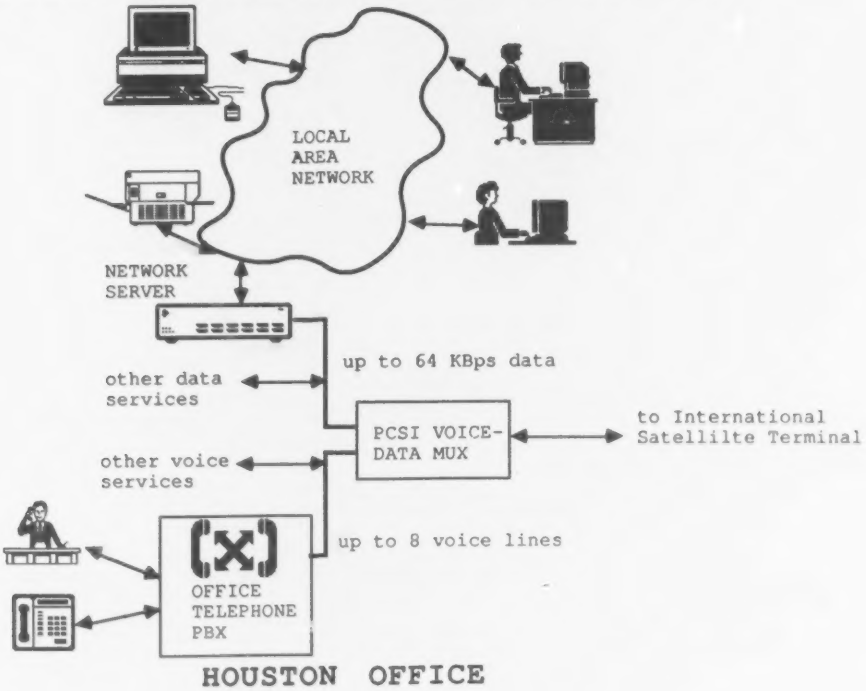
HOUSTON NETWORK INTERCONNECTION



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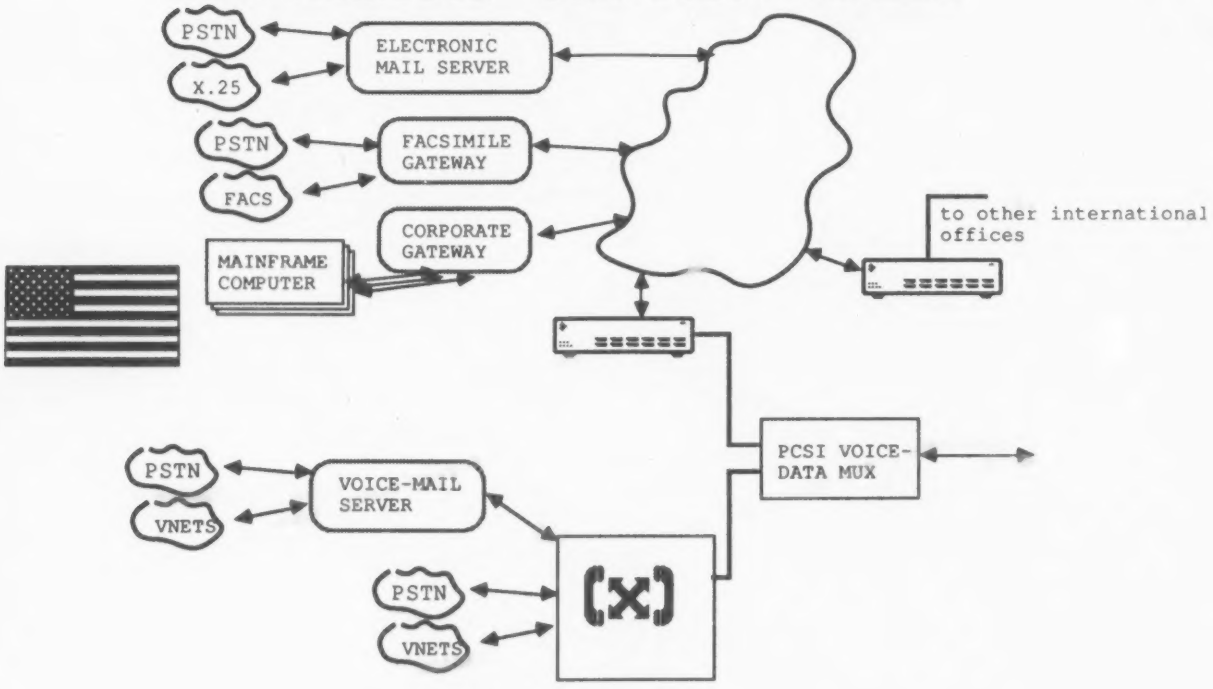
INFORMATION SERVICES ACCESS



HOUSTON OFFICE

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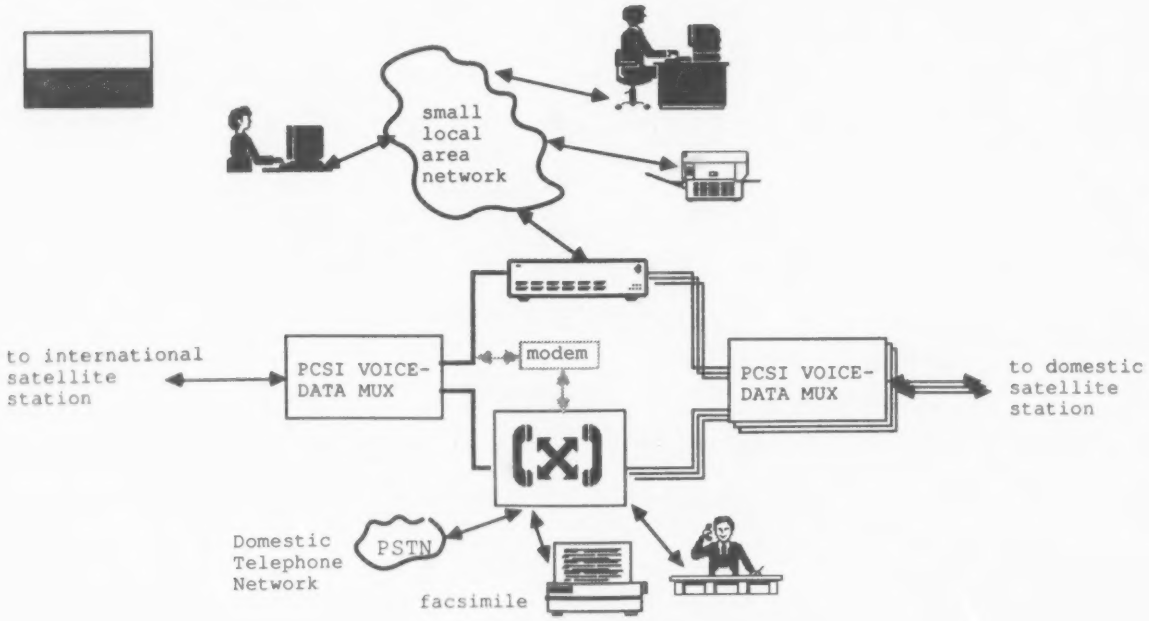
JAKARTA OFFICE CONFIGURATION



JAKARTA OFFICE

Office to local PSTN C.O. connections in terms of transmission levels, return loss, and channel noise. This eliminates variations in the quality of satellite-interconnected PSTN calls due to "bad" C.O. trunks.

The 4-wire (as opposed to 2-wire) C.O. interface eliminates the process of 4/2-wire conversion at Houston Office Switch, followed by a 2/4-wire conversion at the local PSTN C.O. Each of these conversions introduces an impedance mismatch, causing transmission losses (decreased Signal to Noise Ratio;SNR) as well as power reflections (echo) in 2-wire C.O. interfaces.

The 4-wire transmission path between the PSTN C.O. and the Houston Office Switch removes two sources of circuit impairment. Similarly, the PCSI unit's support of a 4-wire (as opposed to 2-wire) interface with the Houston Office Switch removes two more impairment sources.

By configuring the Houston Office Switch to support (a) digital C.O. interface and (b) 4-wire PCSI connection, five sources of circuit impairment are eliminated. As a result, PSCI unit connection to the local PSTN C.O. has the same speech quality as the Houston Office Switch.

Digital Transmission to PSTN C.O.'s:

The US PSTN is being rapidly upgraded to digital transmission using digital C.O.s. As a typical example, Indiana Bell, recently retiring it's last electromechanical C.O., already provides digital service to 47% of it's subscribers.(4) Therefore, calls to many PSTN C.O.s are handled in the original digital transmission format used by the Houston Office Switch.

Digital transmission to PSTN C.O.'s eliminates speech quality degradation due to A/D & D/A conversion, analog trunk noise, poor return-loss, and variations in transmission levels. These impairments, inherent in Analog networks, represent the major sources associated with transmissions between PSTN C.O.s.

The Houston Office Switch is configured to provide a transparent 4-wire digital interface between the PCSI unit and the US PSTN. Satellite interconnected calls made to any digital C.O. in the US PSTN suffer no transmission impairments up to the subscriber loop.

Analog Subscriber PSTN Connection:

Digital transmission between the Houston Office Switch and most US PSTN C.O.s leaves 2-wire analog subscriber lines (local loops) as the prime source of speech quality degradation in PSTN-interconnected calling.

A/D & D/A conversion distortion, Analog noise, poor return-loss, and variations in analog transmission levels are the major contributors to speech quality impairments in a digital network with digital C.O.s using 2-wire analog subscriber lines. Drawing from almost a century of expertise, the US Telephone Companies have learned to design and maintain C.O. Equipment and Outside Plant to provide an exceptional level of service using 2-wire analog loops. Unfortunately, this level of service extends only up to the subscriber's premises. Subscriber-supplied apparatus, such as low-cost telephones, office key-systems, and cordless phones, routinely fail to comply with PSTN specifications. Presently, this is a major factor in speech quality degradation for PSTN-interconnected satellite calls.

Digital Loops; Nearing Optimal Speech Quality

The US Telcos' steady introduction of digital services to business subscribers is beginning to expand into residences. These digital services eliminate the degradation caused by analog loops, thereby improving the quality and consistency of calls involving satellite interconnection to the US PSTN.

The US Telcos have already begun installing fibre from the C.O. to subscriber premises. By the year 2000, over 40 million US telephones will be served by fibre. (2)

DSP-based Telephones; Improving Loop Performance:

The use of sub-spec subscriber apparatus will wane rapidly with the advent of "intelligent services", such as caller identification, offered by the US Telcos. A new bread of DSP-based (Digital Signal Processor) telephone products will actually enhance 2-wire analog line performance through noise cancellation, transmission level correction, and return-loss impedance matching.

As the precursor to ISDN, DSP-based telephones will enhance the performance of 2-wire analog subscriber lines, making the speech quality of US PSTN-interconnected and internal Houston Office satellite calls virtually identical.

interconnecting through the Houston Office Switch, deliver optimal speech quality when calling the Jakarta Office and/or Remote Site(s).

SHEET NINE

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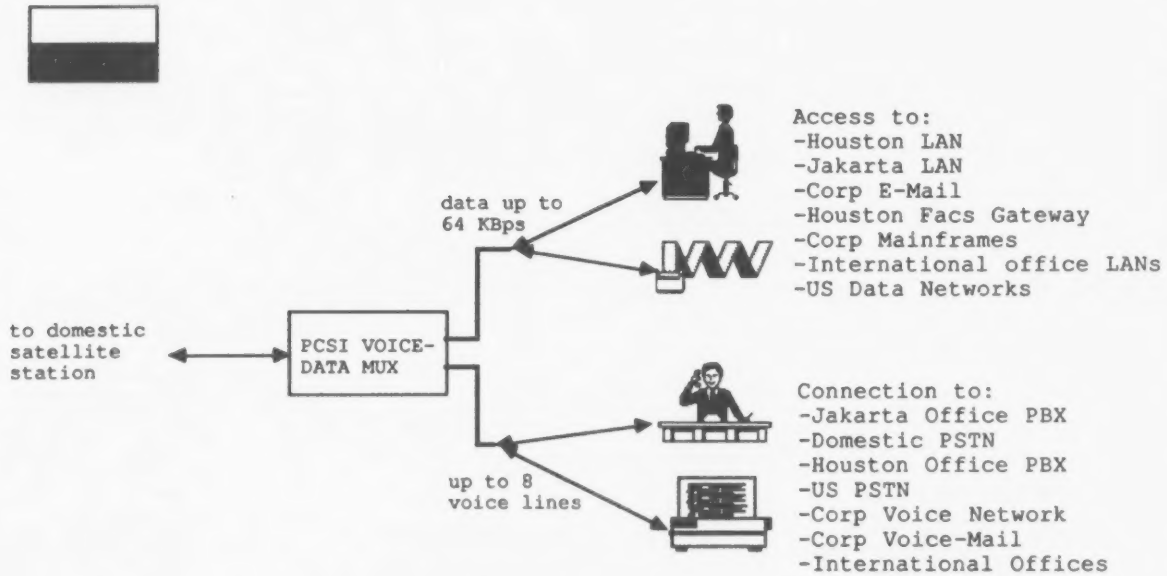
REMOTE SITE CONFIGURATION



REMOTE SITE

Cellular Interconnection; Echo-Free:

Cellular telephones, employing a 4-wire interface for interconnection to the US PSTN, do not use the 2/4 & 4/2-wire hybrid converters required in 2-wire analog subscriber loops. Sheet Twelve depicts a Cellular Telephone {1} given 4-wire interconnection to the digital US PSTN. The digital interface between the US PSTN and HOU Office Switch enables seamless 4-wire transmission up to the PCSI Voice/Data MUX shown in Sheet Six.

This network configuration maximizes the benefits available from cellular's 4-wire interconnection to the US digital PSTN. With service throughout urban USA, cellular telephones,

Echo-Cancellation; A 2-wire Reality:

Many non-cellular PSTN interconnections, using 2-wire analog subscriber loops, suffer degradations in the form of far-end echo, speech clipping, and low transmission levels.

Far-end echo, heard mainly by the Jakarta & Remote parties, is the result of impedance mismatches at the US PSTN subscriber loop 2/4/2-wire hybrid converters. These hybrids cause some of the far-end parties' voice energy to be reflected back along the return speech path. Delayed approximately 1/2 second by the round-trip over each satellite, this reflected energy appears as an "echo" to Jakarta & Remote callers.

The PCSI Voice/Data MUX's use leading-edge DSP technology to provide adaptive echo-cancellation. Despite the recent improvements in their technical capabilities, echo cancellers provide optimal performance only under specific operating conditions.

Considered to be more of an art than a science, echo canceller programming involves the balance of Rx & Tx TLPs, plus the activation/inhibition of signal processing functions including centre-clipping, noise filtering, and return speech cancellation.

PCSI units provide interactive programming of these echo-canceller functions for each voice port in the network. This enables dynamic configuration of voice ports in response to network conditions.
The importance of high quality US PSTN interconnection is clearly demonstrated in an example. Let us suppose the very real probability of an hour long teleconference held at 10am Jakarta time (8pm Houston time), involving five managers; one in the Jakarta Office, another at a remote site, and the remaining three at various US PSTN-connected telephones.

This meeting would simply not be practical without digital PSTN-interconnection.

SUMMARY

As demonstrated by this case study, the combination of international and domestic satellite systems provides a very effective means by which

corporations can extend their international voice and data networks into developing nations.

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3. D.P. Kemp, et al: "An Evaluation of...Voice Coders," MSAT-X (NASA Journal published quarterly), 21, pp.19-24 (October 1989)

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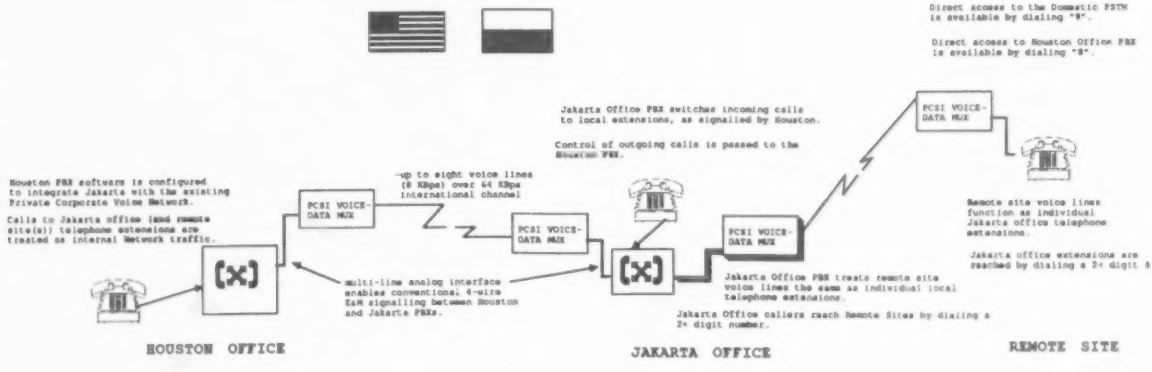
VOICE OPERATION


Direct access to the Domestic PSTN is available by dialing "9".
Direct access to Houston Office PBX is available by dialing "8".
Jakarta Office PBX switches incoming calls to local extensions, as signalled by Houston.
Control of outgoing calls is passed to the Houston PBX.
PCSI VOICE-DATA MUX
Houston PBX software is configured to integrate Jakarta with the existing Private Corporate Voice Network.
Calls to Jakarta office (and remote site(s)) telephone extensions are treated as internal Network traffic.
-up to eight voice lines (8 KBps) over 64 KBps international channel
PCSI VOICE-DATA MUX
PCSI VOICE-DATA MUX
PCSI VOICE-DATA MUX
Remote site voice lines function as individual Jakarta office telephone extensions.
Jakarta office extensions are reached by dialing a 2+ digit #.
multi-line analog interface enables conventional 4-wire E&M signalling between Houston and Jakarta PBXs.
Jakarta Office PBX treats remote site voice lines the same as individual local telephone extensions.
Jakarta Office callers reach Remote Sites by dialing a 2+ digit number.
HOUSTON OFFICE
JAKARTA OFFICE
REMOTE SITE

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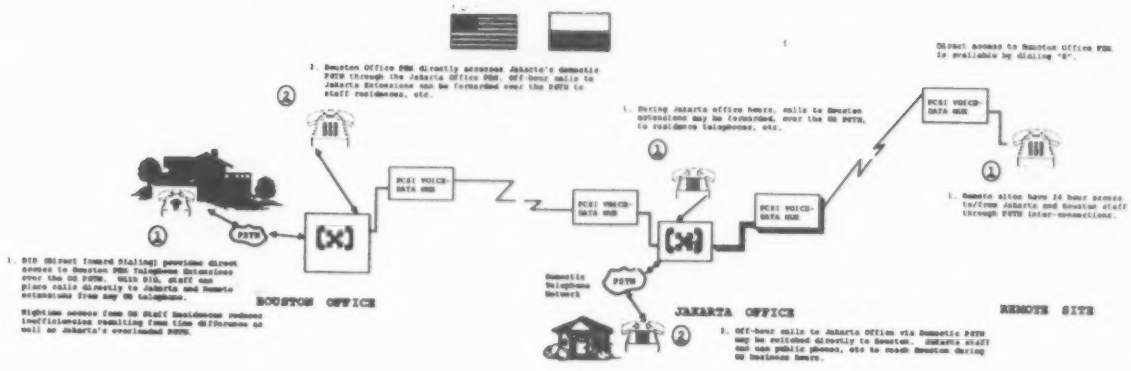
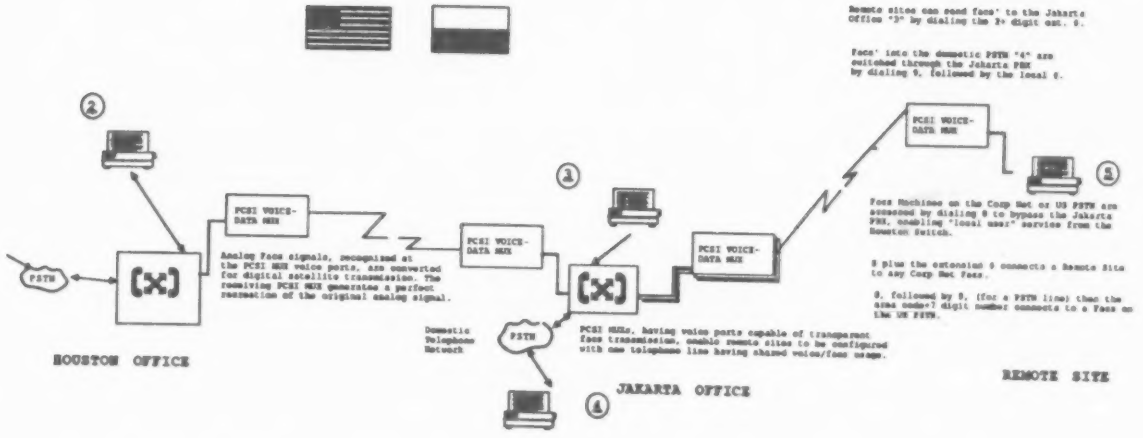
PSTN NETWORK ACCESS



SHEET THIRTEEN ©1991 Infonet Telecommunications Ltd.

FACSIMILE OPERATION



COMPACT DISC QUALITY INTERNATIONAL AUDIO DISTRIBUTION AT C- OR KU- BAND

PAUL A. STERN AND KAY M. NORTON
COMSAT WORLD SYSTEMS
WASHINGTON, D.C.

The authors wish to acknowledge the invaluable assistance of John Phipps and William Sandrin of COMSAT Laboratories in the drafting and editing of this paper.

Abstract

Fixed satellite distribution of high-quality digital audio service is available now. Unlike mobile applications, which may ultimately be provided directly from the satellite to hand-held receivers, fixed distribution would be provided to small C- or Ku-band antennas located at or near existing radio stations for rebroadcast at AM or FM, direct to hotel rooftop antennas or to cable headends for rebroadcast on existing cable networks.

1.0 Introduction

At the outset, it is important to distinguish digital audio distribution service from its more well-known relation, digital audio broadcasting (DAB) service. The term DAB is generally used to refer to direct-from-the-satellite L-band transmission into small handheld or car receivers. Although several U.S. companies have proposed DAB satellite networks, this service is not expected to be available for several years, pending development of receivers and resolution of several international and domestic regulatory issues.

The service discussed in this paper, digital audio distribution service, is multipoint distribution of high-quality audio, up to compact-disc (CD) quality, into small (e.g., 1.8 or 2.4 meter) fixed C- or Ku-band antennas. Unlike digital audio broadcasting service, this service is available now.

2.0 The Market

The small receive antennas for digital audio distribution service would typically be located at AM or FM radio stations, hotel rooftops or cable headends. Signals received by these radio stations would be rebroadcast at AM or FM; those received at hotels would be distributed throughout the hotel; and those received by cable headends would be distributed to listeners in much the same way that cable TV is distributed to viewers.

For listeners of programming rebroadcast at AM or FM, some of the frequency response advantages would be lost in the retransmission and thus CD quality reception is not presently possible. This will continue to be true until frequencies are set aside and receivers developed for digital audio reception. However, even in the case where the end product is analog, digital transmission is superior to analog for signal storage and long-distance distribution. The fewer conversions between analog and digital, the higher the ultimate signal quality will be.

Although AM and FM listeners must wait for CD-quality audio, cable radio subscribers can enjoy the full benefits of high-quality international digital audio immediately. Many listeners are already enjoying digitally delivered, commercial-free programming in domestic applications (including jazz, classical, country, rock, live concerts and sports). Service providers such as Digital Cable Radio, a partnership of Jerrold Communications and three top U.S. cable operators; and Digital Music

Express, a subsidiary of International Cablecasting Technology, are offering a 24-hour premium cable audio service featuring digital sound that is transmitted to subscribers' stereo receivers via their cable television systems.

3.0 Principles of Compression

The ideal range of human listening is 20 - 20,000 Hz with loudness sensitivity varying by frequency. The digital audio coders currently being marketed divide this range into a large number of smaller bands based roughly on the acoustic response of the human ear. These individually coded smaller bands are transmitted with an error protected control word which is used to reconstruct the input signal in the decoder.

This coder technique can be more easily understood when considered in the context of a single piano note. For example, the fundamental frequency of the D_6 key on a piano is about 1175 Hz. When the key is struck and the note passed through a coder, only the frequency band which contains those narrow tones associated with the D_6 key are activated. Slight coding inaccuracies which result in low-level noise are limited to the same space already occupied by the much louder D_6 note, which effectively "masks" this noise.

By using sophisticated source coding/compression techniques, the space segment required for transmission of high quality signals can be dramatically reduced. For example, the recently adopted ANSI standard for audio encoding (ANSI T1.305-1990) requires a 384 kbit/s transmission rate per monaural channel for program audio with a 15 kHz bandwidth. With currently available compression equipment, this same transmission could be accomplished at a transmission rate of 64 to 128 kbit/s.

Several organizations have developed algorithms for identifying inaudible sounds. The most tested and documented algorithms include the Masking-Pattern Universal Sub-band Integrated Coding and Multiplexing system (MUSICAM), Audio Processing Technology, and two proprietary systems developed by Scientific Atlanta and Dolby Laboratories. These algorithms operate at multiple bit rates, providing flexibility between audio quality and transmission bandwidth.

Manufacturers have incorporated these algorithms into a range of audio products which deliver very high-quality sound at a relatively low cost, while also providing sophisticated network management and control capability.

Table 1 below summarizes the features of the various algorithms. Table 2 provides information regarding currently available audio codecs incorporating these algorithms.

4.0 Quality of Service

While some argue that the quality of FM radio is adequate and that CD-quality audio transmission is unnecessary, it is likely that the public will ultimately demand higher-quality fidelity for both voice and music transmissions. Compact discs and digital audio tapes are becoming increasingly popular for home and automobile use, and consumers will not likely be comfortable stepping down in quality when listening to the radio. In this respect, the radio broadcast industry now lags behind the video broadcast industry, where a higher quality is available over the air than is available for home video viewing.

While available compression technology makes possible the transmission of CD-quality sound with lesser amounts of spectrum, it is important to keep in mind that not all customers will require compact disc quality. Instead, various customers will require different grades of service depending upon the market area, audience and type of transmission. For example, listeners of news, sports and information programming will likely be satisfied with lower fidelity than listeners of music.

TABLE 1. DAB ALGORITHM HIGHLIGHTS

TECHNIQUE	FEATURES
MUSICAM (MASKING-PATTERN UNIVERSAL SUB-BAND INTEGRATED CODING AND MULTIPLEXING)	EUREKA 147 / DAB (IRT, CCETT, PHILLIPS, BTRL, ETC.) SUB-BAND ADPCM LICENSEE: CORPORATE COMPUTER SYSTEMS
SEDAT (SPECTRUM EFFICIENT DIGITAL AUDIO TECHNOLOGY)	ADAPTIVE TRANSFORM CODING SCIENTIFIC ATLANTA PROPRIETARY S.A. SEEKING STANDARDIZATION 56, 64, 96, 128 KBIT/S PER CHANNEL
DOLBY LABS	ADAPTIVE TRANSFORM CODING DP501 / DP502 128 KBIT/S PER CHANNEL
AUDIO PROCESSING TECHNOLOGY (APT-X-100)	SUB-BAND ADPCM 64, 128, 176.4, 192 KBIT/S PER CHANNEL LICENSEE: LNR, COMSTREAM, INTRAPLEX, ETC.

TABLE 2. COMMERCIALLY AVAILABLE DIGITAL AUDIO BROADCAST CODEC SYSTEMS

Manufacturer	System	Modulation	FEC	Eb/No	BER	Audio Card	Band Width	THD	Dynamic Range	S/N
ComStream	DTV100	BPSK or QPSK	1/2	@56 k 5.0 dB	10-7	CDA201	5 Hz - 15.6 KHz (128 kbit/s) 15 Hz - 15.0 KHz	<.08%	>90	>88
			3/4	@56 k 5.8 dB	10-7		5 Hz - 7.8 KHz (64 kbit/s) 15 Hz - 7.5 KHz			
	DT4000	BPSK or QPSK	1/2	@56 k 4.6 dB	10-7	APT coding Algorithm	Available in Mono (128 kbps), Stereo (256 kbps), simplex or duplex			
			3/4	@56 k 5.4 dB	10-7					
LNR	DAVSAT	BPSK (256 kbps) QPSK (512 kbps)	1/2	5.0 dB	10-5	APT coding Algorithm (Optional - Musicam algorithm implementation)				
Intraplex	TDM-153	Digtal Multiplexer				APT coding Algorithm	15 KHz 128 kbps 7.5 KHz in two 64 kbps channels			
Scientific-Atlanta	SEDAT		Information Not Available		up to 10-4	AD7312	20 KHz	N/A	N/A	N/A
						Replacement for DAT card in DAT-32 Receivers Compatable with North American broadcast Standard for satellite delivered digital audio. Proprietary ATC algorithm				
Dolby	AC-2	Audio Codec (RS-449 interface)					20Hz to 15 KHz (256 kbps composite stereo)	<.1%	>90	N/A
						Proprietary ATC algorithm				
Corporate Computer Systems		Audio Codec (RS-449 interface)				Supplier of the MUSICAM algorithm Projected availability: June 91				

Based upon the prevalent standards in the professional and consumer audio industries, four important grades of audio service have been identified. These grades are commonly characterized by the following quality attributes:

a. Transparent CD Quality Service: The required audio signal bandwidth for this grade of service is a 20 kHz channel. Typical transmission rates are approximately 192 to 256 kbit/s per monaural channel, with a required bit error rate of less than 10^{-8}. Signal to quantization noise ratio of greater than 90 dB is expected.

b. Near CD quality service: The required audio signal bandwidth for this grade of service is a 15 to 20 kHz channel. Typical transmission rates are approximately 128 kbit/s per monaural channel, with a required bit error rate of less than 10^{-7}. Signal to quantization noise ratio of between 65 and 90 dB is expected.

c. Broadcast FM Quality: The required audio signal bandwidth for this grade of service is a 15 kHz channel. Typical transmission rates are approximately 64 to 128 kbit/s per monaural channel, with a required bit error rate of less than 10^{-6}. Signal to quantization noise ratio of approximately 60 dB is expected.

d. Broadcast AM Quality: The required audio signal bandwidth for this grade of service is a 5-7 kHz channel. Typical transmission rates are approximately 64 kbit/s per monaural channel with a required bit error rate of less than 10^{-5}. Signal to quantization noise ratio of approximately 45 dB is expected.

Table No. 3 below summarizes the key attributes of each type of quality discussed above.

The signal to noise ratio of greater than 90 dB associated with "transparent" CD quality audio is needed in order to accurately recreate the dynamic range of the analog source. As a practical matter, it is extremely difficult to achieve this standard, particularly for more highly compressed systems. Thus, while several audio codec manufacturers claim to be delivering true, i.e. "transparent" CD-quality, purists argue that what is actually being delivered is "near" CD quality with a signal to noise ratio of 90 dB or less.

In August 1991, at the Satellite Communications Users Conference in San Jose, California, COMSAT World Systems conducted a live satellite demonstration comparing various audio codecs against each other and against uncoded audio. Scientific Atlanta, Dolby, LNR and Intraplex all participated in the demonstration, each representing one of the four principal compression algorithms. A digital audio tape recorder was used as source material for all four digital audio systems. Various music and speech samples had been previously recorded onto the DAT from the compact disc. The DAT source material was then routed through each coder and transmitted via the INTELSAT 174 ° east satellite using a 2.4 meter transportable antenna. The

TABLE 3. AUDIO CODEC CHARACTERISTICS

Quality	Typical Coding Techniques	Channel Bandwidth (kHz)	Transmission++ Rate (kbit/s)	SNR *	Minimum BER +
CD	Waveform	20 kHz	192 - 256	> 90	< 10-8
Near CD	Parametric	20 kHz	128 - 192	65	< 10-7
Broadcast FM	Parametric	15 kHz	64 - 128	60	< 10-6
Broadcast AM	Parametric	5 - 7 kHz	24 - 64	45	< 10-5

* Signal to Noise Ratio in dB + Minimum bit-error rate, assuming no FEC ++ Per Monaural Channel

four signals were received using the same antenna and fed into the decoder and ultimately into a central switcher, allowing demonstration participants to directly compare each signal and the DAT source. Figure 1 below is a block diagram of how this demonstration was configured.

Although listeners to the San Jose demonstration were told in advance whether they were listening to coded or uncoded audio, many audio experts and most casual listeners indicated that they heard no difference between the two audio sources or between the various algorithms. In "blind" tests given by Scientific Atlanta and others, where listeners were asked to distinguish between coded and uncoded audio, very few were able to do so on more than a random basis. Thus as a practical matter, the term "CD quality" has become synonymous with both near and transparent CD quality.

5.0 System Design and Spacecraft Capacity

The design of an economically practical digital audio service via satellite requires careful consideration of a number of system parameters, including transmission rate, receiving earth station size, availability, modulation and coding.

The most efficient system design is to optimize the entire transponder for digital audio services. This results in the least amount of bandwidth per channel and thus the greatest number of channels per transponder. When the transponder is operated under a shared arrangement there will be constraints placed on the system by the other carriers.

FIGURE 1. BLOCK DIAGRAM OF COMSAT DIGITAL AUDIO DEMO - AUGUST 1991

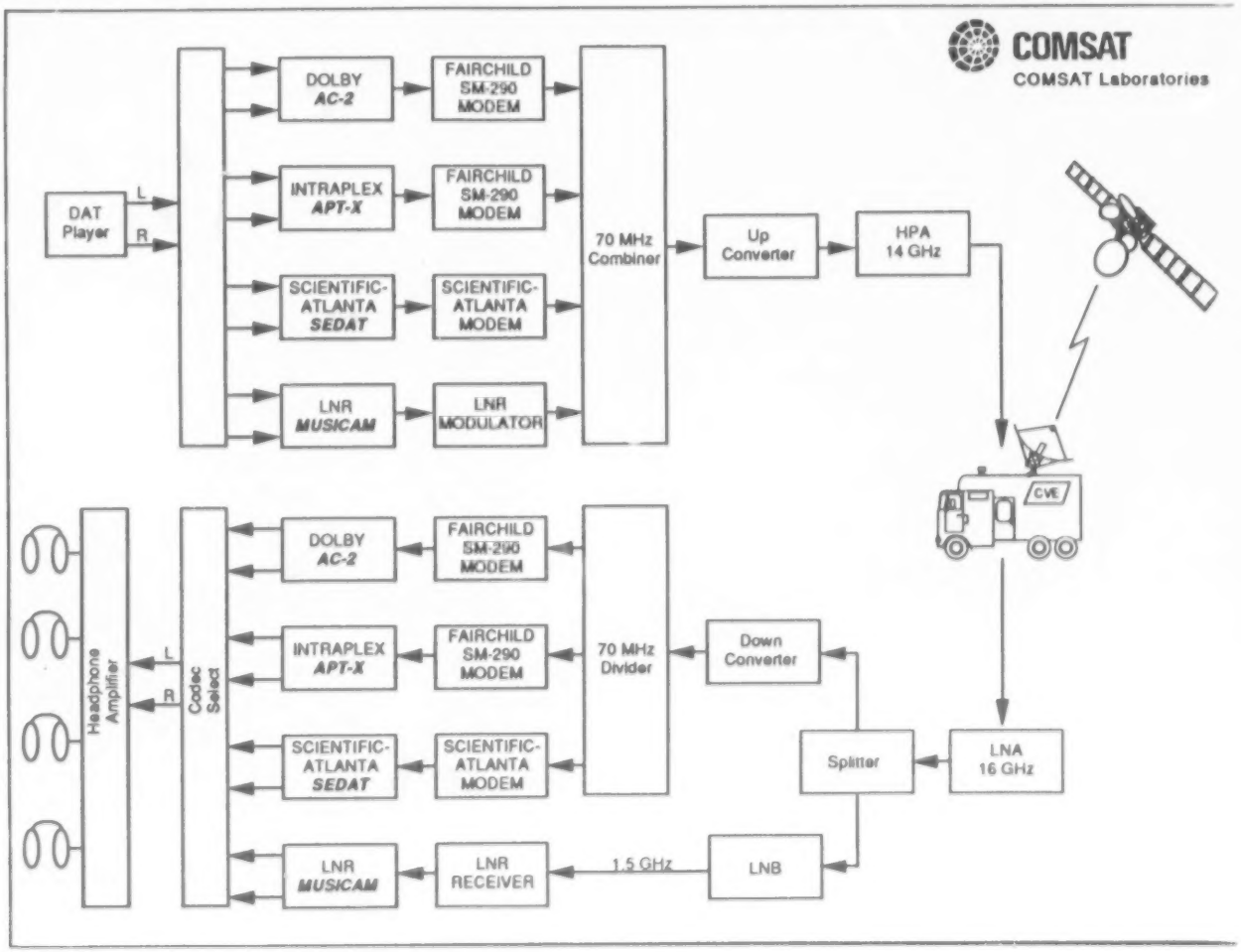


Table 4 below summarizes capacity calculations under an optimized scenario.

As can be seen from Table 4, transmission via the INTELSAT-K satellite, expected to be in operation in the Atlantic ocean region by mid-1992, could yield 239 CD-quality stereo channels into a 5.5 meter antenna, 204 channels into a 3.5 meter antenna, 121 channels into a 1.8 meter antenna, and 70 channels into a 1.2 meter antenna, based on a 5 dB system margin. This chart is based on an optimized system design and the use of a special codec design suggested by COMSAT Labs, which uses additional outer coding techniques.

Table 4 also reveals the sensitivity of digital audio networks to the size of the receive antennas and the assumed system margin, which is required as protection against rain impairments. In most digital audio networks, margin selection will be somewhat complicated by the point to multipoint nature of the service, where some receiving earth stations may be in climates much different than others. Because excess margin translates into additional spacecraft resources, it would probably be wise to select a baseline margin based upon nominal or representative propagation conditions, and then require receiving earth stations located in areas of severe rain impairments to use larger receive antennas.

TABLE 4. SUMMARY FOR THE OPTIMIZED SERIES OF SYSTEM CAPACITY CALCULATIONS EXAMPLES

	Number of DAB channels			
	5	2.9	1.8	meters
IS V (72 MHz, High)	79	36	15	
IS V (72 MHz, Low)	79	30	12	
IS VA (72 MHz, High)	78	36	16	
IS VA (72 MHz, Low)	79	34	13	
IS VI (72 MHz, High)	121	51	25	
IS VI (72 MHz, Low)	121	50	22	
C-band (3 dB system margin)				

	5.5	3.5	1.8	1.2	meters
IS V/VA (72 MHz, High)	105	57	29	17	
IS V/VA (72 MHz, Low)	116	59	29	16	
IS VI (72 MHz, High)	175	110	45	31	
IS VI (72 MHz, Low)	182	119	45	31	
IS K (54 MHz, High)	50	50	42	34	
IS K (54 MHz, Low)	188	136	63	39	
Ku-band (7 dB system margin)					

	5.5	3.5	1.8	1.2	meters
IS V/VA (72 MHz, High)	182	121	46	28	
IS V/VA (72 MHz, Low)	182	121	46	28	
IS VI (72 MHz, High)	242	182	82	49	
IS VI (72 MHz, Low)	273	182	84	49	
IS K (54 MHz, High)	110	104	81	57	
IS K (54 MHz, Low)	239	204	121	70	
Ku-band (5 dB system margin)					

In addition to receive earth station size, the gain setting of the satellite and the uplink power will also impact upon system margin. As shown in Tables 4, in some instances, capacity is dramatically increased by using the low gain setting on the satellite which requires use of more uplink power without saturating the transponder. For example, assuming optimized system design with 7 dB system margin, switching the INTELSAT-K satellite from the highest gain to the lowest gain high to very low gain setting more than triples (from 50 to 188) the number of CD quality channels that can be transmitted into a 5-meter antenna.

6.0 Digital Audio Distribution Service in the Pacific Ocean Region

The linguistically, politically and culturally diverse countries of the Pacific region make up the fastest growing and perhaps the most dynamic media market in the world. This market ranges from the limited broadcasting systems in Cambodia and North Korea, where radio is the main source of information, to the multi-channel video services available in Japan, Australia and Thailand. Several Pacific countries have cable networks and pay-TV services, and most offer satellite-delivered programming.

While direct-to-cable premium audio services are likely to be first implemented in the Pacific region by countries with the fastest growing economies, other forms of digital audio distribution service are also well suited to the region. For example, "narrowcasting" -- transmission of programming aimed at relatively small cultural, religious or other audiences -- is ideal for an area as culturally diverse as the Pacific region.

Another potentially lucrative market for the Pacific region is the distribution of Western programming to hotels. News and entertainment tailored for tourists and business travelers could be received directly from the satellite using small roof-top antennas.

Direct-to-home reception of high-quality audio will become more feasible for the Pacific region with the development of even smaller (less than 1 meter) receive-only dishes which can be wired directly into a home stereo receiver. This form of audio distribution is similar to the direct-to-cable market -- allowing CD-quality programming to be transmitted directly to the listener.

The U.S. and Europe will likely lead in the proliferation of high-quality digital audio services over satellite. However, as the marketplace and regulatory environment evolve, these types of radio services may become increasingly available in the Pacific region as well. In the meantime, Communications Agencies and Licensed Radio Operators can take advantage of the economies provided by digital compression and transmission techniques by offering a diversity of music, news, weather and entertainment programming to Pacific region audiences.

7.0 Conclusion

Development of audio compression equipment is making transmission of high- quality digital audio via satellite economically attractive. Several providers of domestic cable-delivered digital radio programming have proposed expanding their network to points in Europe via the INTELSAT system and it is likely that before the end of 1992, many European listeners will have as many as 60 channels of commercial-free CD quality music available to them. Until direct-to-receiver DAB services become technically and economically feasible (and even afterwards for certain urban and other regions), broadcasters should consider use of COMSAT's digital audio distribution service for transmission of high quality audio programming.

8.0 Contact

For further information about COMSAT's international digital audio distribution service, please contact:

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Cable Network in the Pacific and Asia Region and Optical Submarine Cable Technology

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The number of optical submarine cables in the Pacific and Asia region is growing rapidly these days. This trend could be interpreted as the effort to achieve the integration of the Pacific and Asia region. Furthermore, this trend has been expanding in the world to form global network. This paper reviews the present status of optical submarine cable network in the Pacific and Asia region and its technologies.

1. Introduction

Development of optical fiber submarine cable systems commenced in the late 1970's at various countries taking into account the growing demands for more advanced telecommunication services and remarkable progress in optical transmission technologies. Through the prototype manufacturing and various evaluation tests including field test of repeaters and cables, optical fiber submarine cable systems were confirmed to be of practical use.

As a result, optical fiber submarine cable systems were decided to be used in the Hawaii Cable No.4/Transpacific Cable No.3 (HAW-4/TPC-3) which were put into service in 1989 as the first long-haul international optical fiber submarine cable systems in the Pacific and Asia region.

In succession of HAW-4/TPC-3, Guam-Philippine-Taiwan cable (G-P-T), Hong Kong-Japan-Korea cable (H-J-K) were put into service in 1990, and construction of Transpacific Cable No.4 (TPC-4), ASEAN Optical Fiber Submarine Cable Network (AOFSCN), PacRim East/West and APC are now in progress. Furthermore, TPC-5 Cable Network are planned to be constructed in the middle of 1990's with new technologies and restoration arrangement.

This paper reviews the present status of optical submarine cable network in the Pacific and Asia region and its technologies.

2. Cable Network in the Pacific and Asia Region

Since the optical fiber submarine cable system can provide high quality, high reliability and large capacity digital transmission, construction of the optical submarine cable network is being promoted extensively.

So far, over 30,000km of optical submarine cable including HAW-4/TPC-3, G-P-T, H-J-K and NPC are now in service, and the construction of over 40,000 km optical submarine cables including TPC-4, AOFSCN, PacRim East/West and APC are in progress. Furthermore TPC-5 network, total length of 25,000 km, is now planned in the Pacific and Asia region.

Fig.1 shows optical submarine cable network in the Pacific and Asia region. Solid lines indicate optical submarine cables which are now in service and dotted lines indicate optical submarine cables which are now under construction or planning stage.

Those optical submarine cables improve the transmission quality of the international telecommunication and are expected to play a major role to construct the worldwide ISDN (Integrated Service Digital Network).

(1) HAW-4/TPC-3

HAW-4/TPC-3 consist of the TPC-3 cable linking Hawaii, Japan and Guam by a Branching Unit and the HAW-4 cable linking Hawaii and U.S. mainland.

TPC-3 cable is the integrated system of OS-280M system and SL-280 system using 1.3 um technology. Total system length is approximately 13,300 km (HAW-4; 4,200 km, TPC-3; 9,100 km) and repeater spacing is 50 - 70 km. The total cable capacity is 560 Mbps (7,560 channel - 64 Kbps/channel) for the HAW-4 cable with two working fiber pairs, and 280 Mbps (3,780 channel - 64 Kbps/channel) for each fiber pair between Hawaii/Japan, Guam/Japan and Hawaii/Guam in the TPC-3.

(2) H-J-K

H-J-K cable was put into service on May 1990, linking Hong-Kong, Japan and Korea by a Branching Unit. H-J-K cable is also the integrated system of OS-280M and SL-280. Total system length is approximately 4,600 km. The cable capacity is 280 Mbps (3,780 channel - 64 Kbps/channel) both for Hong-Kong -Japan, Korea-Japan. (There is no fiber pair between Korea and Hong-Kong.)

(3) ASEAN Optical Fiber Submarine Cable Network

In the ASEAN region, the construction of optical submarine cable network such as Burunei-Singapore, Burunei-Malaysia-Philippine etc are in progress. These ASEAN optical submarine cables will constitute an optical submarine cable network in the Pacific and Asia

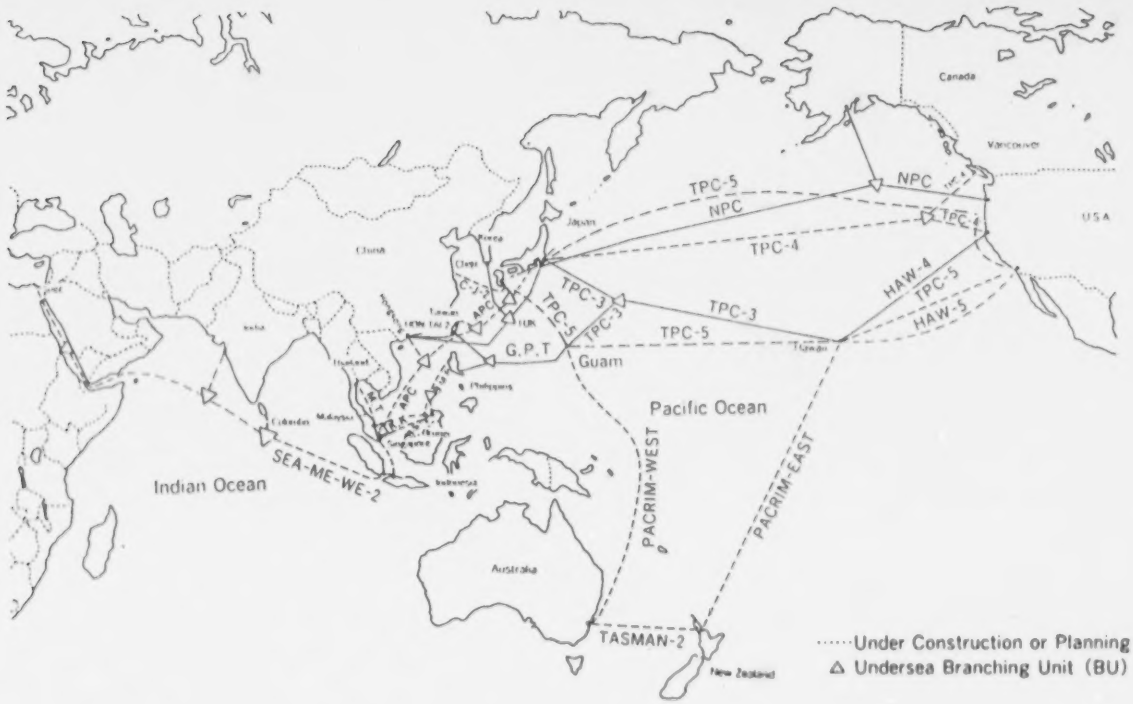

Fig.1 Optical submarine cable network in the Pacific and Asia region

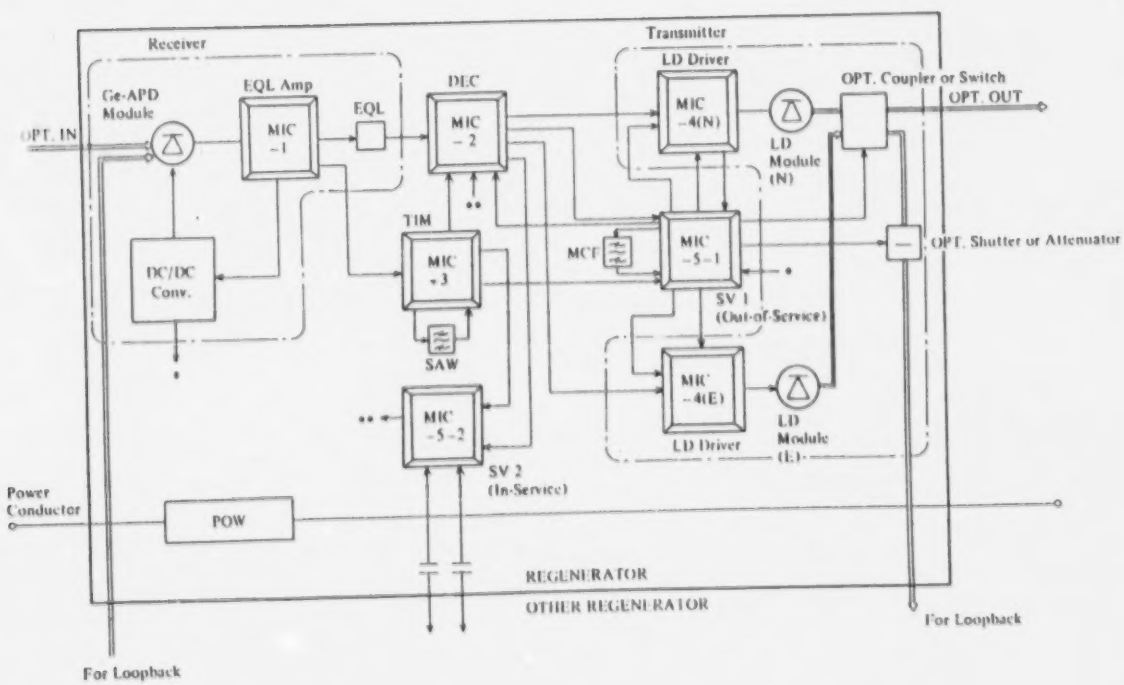

Fig.2 Regenerator circuit of OS-280M optical submarine repeater

region through connection with the HAW-4/TPC-3, H-J-K, APC and G-P-T cable etc.

(4) TPC-4

The construction of the TPC-4 cable which connects Japan with U.S. mainland and Canada by a Branching Unit is now in progress toward the Ready for Service date at the end of October 1992 to cope with the increase of telecommunication demand in the Pacific and Asia region.

The TPC-4 cable is the integrated system of OS-560M system and SL-560 using 1.55 um technology. Total system length is approximately 9,800 km and repeater spacing will be 130 - 150 km which is more than double of 280M systems thanks to the low loss fiber at 1.55 um wavelength. The total cable capacity is 1,120 Mbps (15,120 channel - 64Kbps/channel) with two working fiber pairs.

(5) PacRim East/West and TASMAN-2

The construction of the PacRim East/West and TASMAN cables are being conducted to meet the growing traffic demand between Australia/New Zealand and the Asia/North America/Europe. If either one of the PacRim East/West cables should fail, it can be restored by the other cable through the loop network formed by connecting the system with HAW-4/TPC-3 and TPC-4 cables in the North Pacific.

PacRim East is the integrated system of SL-560 system and S-560 system. PacRim West and TASMAN-2 will be constructed by S-560. Total system length is approximately 16,800 km (PacRim East; 7,700 km, PacRim West; 6,900 km, TASMAN-2; 2,200 km).

(6) APC

APC Cable is to link Singapore, Malaysia, Hong-Kong, Taiwan and Japan (Miyazaki, Miura) with four branching units and total length is 7,300 km. The construction of APC Cable is now in progress toward the RFS date of middle of 1993. APC cable system is the integrated system of OS-560M and SL-560.

(7) TPC-5 CN

TPC-5 Cable Network will link Japan, U.S. mainland, Hawaii and Guam in loop (25,000 km in total length) and each segment will contain working fiber pair and restoration fiber pair of 5 Gbps (60,480 channel - 64 Kbps/channel) By this configuration, traffic between any two points on this network can be carried on two different routes and thus can be restored at once if a fault occurs in this loop. Namely, TPC-5 CN will be constructed with a so-called self-healing concept in 1995/1996 and will be able to form a remarkably high quality and highly reliable cable network.

With regard to the technology aspect, TPC-5 CN will adopt Optical Amplifier technology with a transmission capacity of 5 Gbps which is currently under development.

3. Optical Submarine Cable Technology

(1) 1.3 um Wavelength Technology

Optical submarine cable systems using 1.3 um wavelength technologies are identified as the first generation optical submarine cable systems. The features of the first generation optical systems are that all operate at 1.3 um wavelength, where one of low loss bands in silica base optical fiber exists and dispersion became minimum, and as for the line bit-rate, 295.6 Mbps is adopted, which is based on CEPT-4 (139.264 Mbps).

The transmission bit-rate is 280 Mbps which provides 3,780 channel (64 Kbps/channel). These are used in TAT-8 which is the integrated system of SL-280, NL-2 and S-280, and TPC-3 which is the integrated system of SL-280 and OS-280M. Basic parameter of those systems such as optical wavelength, line current, line code and frame format are coincided so as to interconnect each other through the TAT-8 and TPC-3 integration development testing. The reliability target for long-haul submarine cable systems is less than three ship repairs over the 25 years of system design life. To meet this demand, the reliability test for the repeater components such as LD, APC/PIN diode, optical components and MIC have been carried out extensively[1], and several redundancy techniques are adopted. Fig.2 shows the highly integrated OS-280M optical submarine repeater circuit to follow the reliability objectives described above.

Regarding the optical submarine cable, long-term reliability and stable operation are essential under the high tension conditions during the cable laying/recovering and under the high pressure/low temperature condition on the deep sea floor in the practical use. Considering these requirements, optical submarine cables are designed to protect optical fibers from high water pressure and high tension force, and also optical fibers used in submarine cables are proof tested at an appropriate strain such as 2% in case of the OS-280M cable. Fig.3 shows OS-280M optical submarine cable (Light weight type). The average loss of the OS-280M cable is about 0.36 dB/km, and the repeater spacing is 50 km - 70 km[2].

(2) 1.55 um Wavelength Technology

Optical submarine cable systems using 1.55 um wavelength technologies, where optical attenuation of a silica based fiber is minimum, are identified as the second generation optical submarine cable systems.

Fig.4 shows the relationship between repeater spacing and transmission bit rate depending on the fiber type and LD type[3]. DFB LD, which has an excellent single mode characteristic, and 1.55 um cut-off wavelength shifted optical fiber, which has zero dispersion wavelength at 1.3 um, is a reasonable combination for up to 600 Mbps transmission because low loss

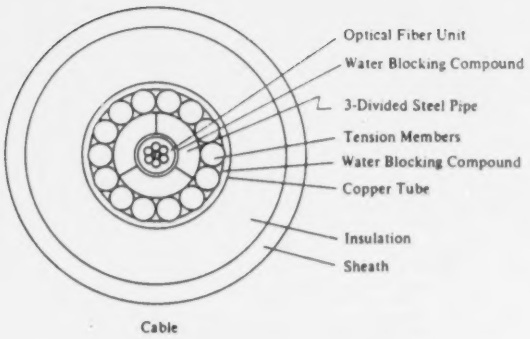

Fig.3 OS-280M optical submarine cable cross section

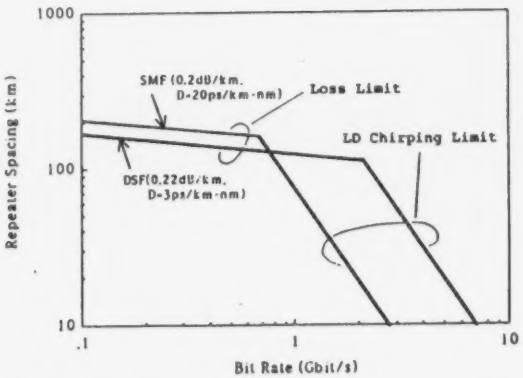

Fig.4 Relationship between repeater spacing and transmission bit-rate

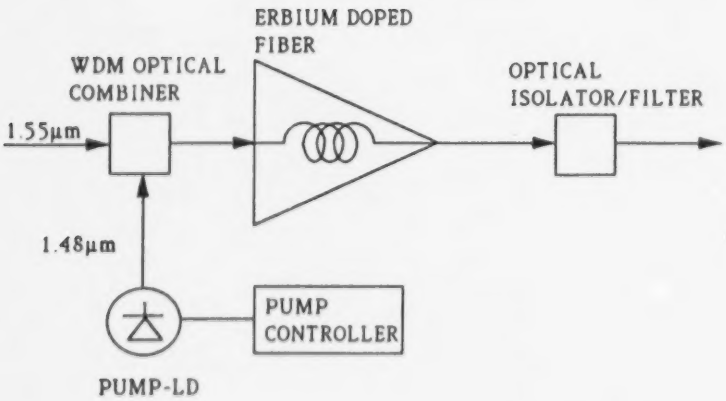

Fig.5 Schematic diagram of optical amplifier circuit

characteristics of silica based optical fiber can be made good use with a little mode partition effect.

OS-560M system, which is applied to the TPC-4, APC etc is based on the OS-280M system and following newly developed technologies are adopted.

a) 1.55 um optical transmitter/receiver
b) Low loss optical fiber
c) High speed MIC
d) Repeater supervisory circuit
e) Transmission Terminal Equipment using block synchronous multiplexing
f) Repeater housing and cable coupling

OS-560M cable design is same as that of OS-280M cable except its optical fiber. In order to get lower loss optical fiber, a pure silica core type fiber is adopted. The average loss of about 3,000 km length of manufactured cables is 0.180 dB/km at 1.55 um[4].

Optical transmission power and receiving sensitivity of OS-560M repeater are -1.4 dBm and -38.4 dBm in average, respectively. 130 km - 150 km of repeater spacing is attained thanks to the above cable and repeater characteristics[5].

Similar to the 280 Mbps systems, the basic parameters of 560M systems are also coincided so as to inter- connect each other in the TPC-4 and TAT-9.

(3) OA Technology

Taking into account the demand of the larger capacity optical submarine cable system, the optical amplifier (OA) technologies have been developed over the past few years in place of conventional regenerative system. There are three types of optical amplifiers, that is, a semiconductor laser type, a fiber Raman type and a fiber laser amplifier type[6]. As for the semiconductor laser type, 30 dB gain can be achieved, but its gain depends on the polarization status and coupling loss to fibers is high. As for the fiber Raman type, higher pump power is required and this type will be suitable in non-repeatered system as a booster and a pre-amplifier rather than repeatered system. The fiber laser amplifier using Er^{3+} doped fiber also needs pump power, however, it can be smaller than pump power in the fiber Raman type. The coupling loss to the transmission fiber is small and polarization dependence is also small. The Er^{3+} doped fiber amplifier is considered to be most practical optical amplifier for the submarine cable use. In the OA system, optical signals are directly repeatered without conversion to electrical signals in the repeaters. This means OA repeater will be composed without high speed electronics. The OA system will have the following features.

a) Simple repeater composition
b) Only low speed electronics in the repeater
c) SDH (Synchronous Digital Hierarchy) compatible
d) Bit rate transparent and free from modulation scheme repeater

Fig.5 is a schematic diagram of OA repeater circuit. OA submarine cable system is expected to be applied to TPC-5 CN in 1995 - 1996. So far, recirculating testing was conducted and successful 9,000 km transmission experiment at 5 Gbps transmission speed have been confirmed. This means that feasibility of transoceanic transmission at 5 Gbps is more surely confirmed.

4. Branching Technology

Branching technology is one of the special feature in the optical submarine cable system which was not realized in the coaxial submarine cable system.

Optical submarine cable can accommodate multiple fiber pairs. Consequently, in the cable system, it is now possible to design a device, branching unit, which allows the transmission paths to be split and branched to separate landing stations. This means the branching technology allows us to make more flexible cable planning. APC will have four branching units which will connect six landing points.

Fig.6 shows OS system branching unit which was introduced in the TPC-3. OS system branching unit can provide two features, which are useful in the cable fault condition. One is optical path reconfiguration function and the other is power path reconfiguration function. Namely, one of the branch cable has a fault, service will be re-established using the above two features in the branching unit between the main cable and the other branch cable.

5. Cable to Cable Restoration

In the era of optical submarine cable, service restoration becomes more important than ever before because of the expansion of the large capacity optical submarine cable network and the requirement to minimize the transmission delay. Until now, it was usual to use satellites for back up when cable circuits failed. However, cable capacity in the optical submarine cable become large and it become difficult to keep enough satellite circuits to back up cable circuits. Furthermore, optical submarine cables provide high quality, high reliability and wideband digital transmission circuits which are expected to be applied to data communication, video transmission etc. Users of high speed digital circuits are demanding services via optical submarine cables because of their small transmission delay and high quality, and further they request services complemented and restored mutually by optical submarine cables. The need for cables to back up each other is therefore recognized.

In the TPC-5 Cable Network planning, these requirements are taken into account and TPC-5 cable network will provide restoration facilities in itself.

Fig.6 OS system branching unit

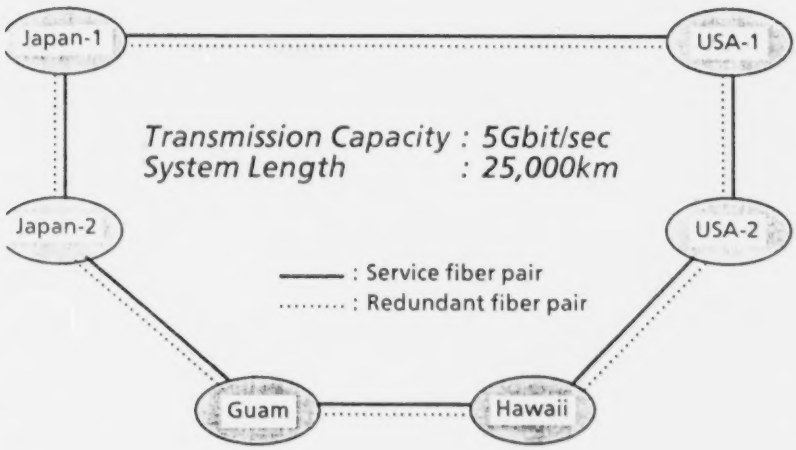

Fig.7 TPC-5 Cable Network configuration

Fig.7 shows TPC-5 Cable Network configuration. Straight line indicates service fiber pair and dotted line indicates restoration fiber pair.

6. Conclusion

This paper describes present status of optical submarine cable network in the Pacific and Asia region and technologies applied in the system. Technologies advancement of the optical submarine cable occurs rapidly owing to the requirements of high reliable/high quality/high capacity transmission. As a result the cable network in the Pacific and Asia region is being expanded rapidly.

7. Acknowledgment

The authors thank Dr. K. Nosaka, Mr. T. Ohta and Dr. Y. Niiro for their encouragement.

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ASEAN OPTICAL FIBER CABLE NETWORK (AOFSCN)

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1.0 Abstract

Optical fiber submarine cable transmission system has emerged as the most economical system for transmitting large amount of digital information in the telecommunication fields. It offers high transmission capacity and quality, low propogation delay, high reliability and security. It is estimated that by 1996 world invesment in optical fiber submarine cables will exceed US $ 11 billion. More than half of this investment will be in the Asia - Pacific Region. It is a well known fact that the Pacific Ocean Region (POR) countries have been extensively connected by optical submarine cables and there are still few projects in que to be implemented. The South East Asia Nations (ASEAN) are also in the race towards efficient global communications and have plan to interconnect all ASEAN countries by submarine optical link by the end of 1994. This network when interconnected to the POR network will begin a new era in telecommunications between the two regions. This paper will present the detail plan of the AOFSCN and its contribution towards a global digital link.

2.0 The Need For a Global Telecommunications Network

The initial trend of economic growth of most Far-East countries was based on inexpensive land and labour, and the abundant natural resources present. Now it has shifted towards manufacturing these resources locally into finished goods. This phenomena is clear from the fact that the internal manufacturing process in these countries have grown dramatically.

However, manufacturing growth requires both international and regional telecommunications. A good communication infrastructure is also needed by the trading and banking services supporting the manufacturing process. So, it is true to say that communications technology will play a vital role in the development of regional and international economies.

In response to intensifying competitive pressures in the global business environment, industry is undergoing a transformation from a rigid hierarchical orientation to a horizontal structure that crosses national boundaries. Increasingly, decisions are being made from a global framework. These decisions can range from a financial transaction to be executed on any one of the bourses in the world, to an operational strategy that allows factories in Europe to handle overflow from other parts of the world.

Intra and intercompany communications are becoming ever more important in daily operations and strategic planning of multi-national business. A reliable global network is in demand to help streamline the distribution of internal information, while enhancing the information exchange process between traders and customers. There have been a significant increase in the usage of telecom services featuring a global environment. It includes facsmile and electronic mail transactions between locations very far apart (with time difference of 8 to 12 hours). Dial-up video conferrencing for example is very attractive and economical at time when intercontinental travel fare is costly.

3.0 Expanding Telecommunications in the Pacific and ASEAN countries

The economic growth of ASEAN countries and the Pacific Ocean Region Countries in the last decade is a fact receiving worldwide recognition. This growth will offer both difficult challenges and interesting oppurtunities in the coming decade. It is an area rich in potential and one where we are

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likely to see some of the most dramatic developments in telecommunications in the years ahead.

The situation of economic activities between these two regions seem to be, capital and expertise located at Pacific Region whereas raw materials and manufacturing operations in the ASEAN countries. So, it is inevitable that telecommunications facilities need to expand to support the increase in business oppurtunities created in these burgeoning markets.

Optical fiber submarine cable transmission system has emerged as the most economical system for transmitting large amount of digital information in the telecommunications fields. Almost all international submarine system installed after 1989 are optical system. There are several optical fiber systems planned worldwide such as TPC-4, HAW-5, TSL, TAT-9, HJK and Asean Optical Fiber Submarine Cable Network (AOFSCN).

It is well known fact that POR countries have been extensively connected by optical submarine cables and there are few projects in the pipeline. Figure 1 summarizes the existing and planned optical fiber submarine systems in the Pacific. The prospective planning for Trans-Pacific cabling clearly shows that the traffic growth is enormous.

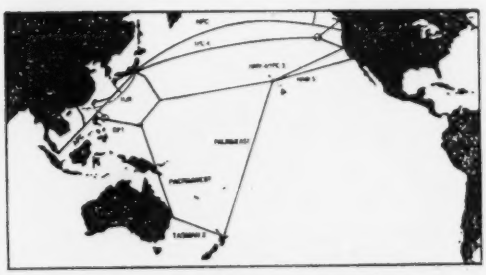

Figure 1: Optical Fiber Submarine Cables in the Pacific

Plan to interconnect all ASEAN countries by submarine optical link was agreed by members in 1988. This led to the acceptance of the Kuantan - Kota Kinabalu (KN - KK) link as part of AOFSCN enabling it to provide transmission capacities for both domestic and international traffic. This link was put into operation since December 1990.

AOFSCN will not only enhance economic activities and political relations between members but the world as a whole. It is an ambitious plan to realise a reliable digital network for the ASEAN region. The whole link will cover a total distance of 4,550 Km with an estimated cost of US $ 320 million. The complete implementation of the plan will end by 1995. Figure 2 shows the AOFSCN configuration.

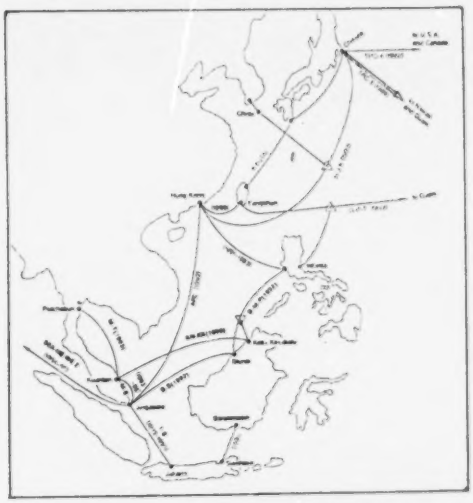

Figure 2: Optical Submarine Cable Network Construction Projects in South East Asia

4.0 AOFSCN

The complete network comprises of six major links as follows:

4.1 Kuantan - Kota Kinabalu Cable System (KN - KK)

This is a 420 Mbps system with two pair of cable. The cost of this 1,500 Km system was M $ 150 million. It has a total capacity of 11,520 voice channel. One pair of the fiber is for domestic traffic and the other is for international traffic.

4.2 Brunei - Malaysia - Philippines Cable System (B - M - P)

This cable will land in Malaysia at Tanjung Aru, near Kota Kinabalu via a branching unit. It is a 1.55 μm system with a total length of 1,600 Km. The capacity of the system is 560 Mbps. It is expected to be ready by 1992. The three landing points will connect via a branching unit which will provide

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interconnections with other digital cable networks in the Pacific for access HongKong, Japan, the United States, Europe and the Pacific Basin.

4.3 Malaysia - Thailand Cable System (M - T)

This is a 560 Mbps system which is expected to be ready by early 1993. Both Telekom Malaysia and Communication Authority of Thailand are involved in the drafting of the tender. It links Cherating Cable Station at Kuantan and Petchaburi Cable Station, Bangkok covering a total distance of 1,000 Km.

4.4 Malaysia - Singapore Cable System (M - S)

This system will link Malaysia and Singapore. It is expected to be ready by 1995. It is a system with a data rate of 560 Mbps. This link will play a major role in connecting ASEAN to the Pacific since it is a portion of the APC system that will link Malaysia, Singapore, Taiwan and Japan.

4.5 Indonesia - Singapore Cable System (I - S)

This 560 Mbps system will be part of the digital South East Asia - Middle East - Western Europe (SEA - ME - WE 2) cable system. This system will be ready in middle 1994.

4.6 Brunei - Singapore Cable System (B - S)

This system will interconnect Brunei and Singapore. The system is expected to be ready by 1992.

It is clear that AOFSCN is a five years plan beginning from 1990. The complete network is expected to be ready by 1995. We can say positively, that the establishment of this project will be able to sustain traffic growth well into the year 2000. This state-of-the-art infrastructure will undoubtedly bring very rapid financial and socio-economic development in this region.

5.0 The Global Digital Link

Prior to 1989, satellite and fiber optic systems was used for transcontinental communication, each providing about 50% of the circuits. At present, experts in long-distance communication are of the opinion that fiber optic systems account for 50 - 60 per cent of the circuits, as against only 30 - 40 per cent for satellite systems.

The acceptance of fiber optic as a large bandwidth, compact and reliable and future-proof system have started an intensive transoceanic cabling plan worldwide. Figure 3 shows the transoceanic fiber optic lines which are either in service already or due to be put into service in the near future.

Figure 3: Global Digital Ring of Worldwide Telecommunications Network

From Figure 3, it is clear that there are three clusters of link making up the world or global telecommunication network namely, European link, Pacific and American link and Asian link. Every link need to be interconnected with each other to create the desired global communication link. Figure 4 shows how the AOFSCN will be interconnected to the Pacific link. It is expected that by 1995, the global digital link will be realised as shown in Figure 5.

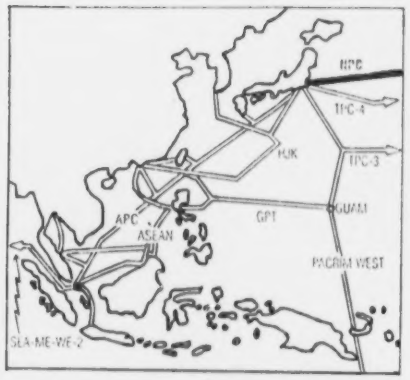

Figure 4: AOFSCN Access to Pacific Region Fiber Optic System

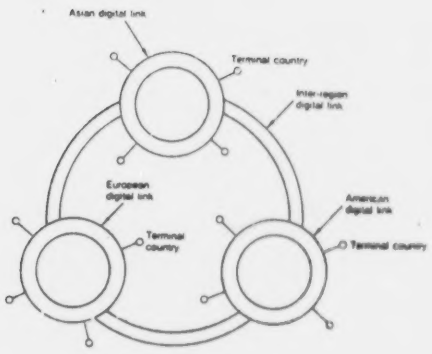

Figure 5: The Future Look of Global Digital Link

6.0 Conclusion

AOFSCN is yet another milestone in realising digital network for the ASEAN region. The linking of this network to the existing and planned POR network is of great political, social and economic importance to the region. It is also an important portion of the global digital communication link. The completion of the whole global link will finally secure a high level of reliability on the world telecommunications network and contribute to strengthening peace and trust between the world nations.

ACKNOWLEDGEMENT

The authors wishes to thank Universiti Teknologi Malaysia for the support given in preparing and presenting this paper. Special thanks to the final year students of electrical engineering for their help in collecting some of the data presented in this paper.

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/T&T
Next Generation Undersea Systems & Technology
Meeting The Needs Of The Global Market

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The next generation of repeatered undersea cable systems are designed for the global market -- offering higher capacities than ever before, increased flexibility and compatibility with emerging international standards and the worldwide intelligent network. These systems, called SL2000 by AT&T, utilize the latest leading-edge technology packaged in a unique design. This design promises to meet customer needs for additional voice capacity while providing increased bandwidth for data, video and other applications.

Historically, the undersea cable system market was driven almost solely by traffic needs. AT&T entered the underwater telephone transmission market in the early 1950's with the first repeatered undersea cable system being installed between the United States and Cuba, providing 24 voice circuits. Following on its heels, the first transatlantic system, named TAT 1, was installed between Newfoundland and Scotland in 1956 carrying approximately 48 voice circuits. A significant growth in the undersea cable system market followed in the 1960's and 1970's to meet the increasing demand for global communications. Technological breakthroughs with semiconductor lasers in the late 1970's then paved the way for faster and more reliable lightwave-based communications and further opened the door for the installation of undersea systems worldwide.

AT&T's lightwave-based systems were initially introduced in the 1980's with 280 Mb/s of transmission capacity, or up to 20,000 voice circuits per fiber pair, meeting virtually any traffic demand of the time. Further advances in lightwave technology have allowed the introduction of the current generation of optical fiber-based systems. These systems, called SL560 by AT&T, provide 560 Mb/s of transmission capacity or up to 40,000 voice circuits per fiber pair. This generation of lightwave systems is comprised of the following major components & technology:

- regenerative repeaters - bit-rate sensitive repeaters which allow the recreation of the transmission signal along the transmission path of the system allowing for longer undersea systems
- terminal transmission equipment - equipment which connects the undersea system to the terrestrial network, or another undersea system, via a 140 Mb/s interface
- power-feed equipment - equipment which provides up to 1.6 amperes of current to the underwater equipment
- optical fiber - provides the optical transmission and signaling paths of the system
- cable - protection for the optical fiber
- branching repeaters - optional repeaters providing signal regeneration, multiple landing site access and switching capability

These components and technology provide SL560 systems with the capability of supporting up to three (3) fiber pairs, thereby maximizing system capacity at 120,000 voice circuits per system. Other attributes of the SL560 technology include a system design life of 25 years, higher performance, and increased reliability over previous technology. The introduction of the new branching repeater provides additional flexibility by allowing access to multiple landing sites and the capability of switching traffic from one destination to another. These attributes ensure that undersea cable customers can meet existing traffic demands with increased reliability and flexibility. The first transatlantic 560 Mb/s system, TAT 9, was installed in 1991.

As undersea systems have evolved, so have customer requirements. Current undersea cable system owners now plan to exceed forecasted traffic demand due to the use of services that require more capacity,

such as, real-time video transmission. These customers are also demanding more stringent performance and reliability, lower costs, compatibility with evolving international standards and the flexibility to meet the world's changing telecommunications needs in shorter timeframes. Tomorrows undersea systems must be able to meet these needs.

The next generation of repeatered undersea cable systems are designed to meet these customer's expectations. These systems are designed to offer up to 5.0 Gigabits (Gb/s) of transmission capacity or up to 160,000 voice circuits per fiber pair. This kind of increased capacity means overall reduced unit costs to customers. These systems also provide the flexibility of supporting 2.5 Gb/s and/or 622 Mb/s of transmission capacity meeting the needs of those customers with lower initial traffic requirements. These customers may, if the maximum transmission rate they require (for example, 5.0 Gb/s) is planned and installed, change the transmission rate of the system (for example, from 2.5 Gb/s to 5.0 Gb/s) by changing the terminal equipment only at any time during the system life.

Additionally, up to four (4) fiber pairs will be supported providing up to 640,000 voice circuits per system. SL2000 systems will also operate over longer distances than previous systems -- over lengths of up to 9,000 kilometers, and offer a branching unit should customers require multiple landing sites. These systems will meet or exceed CCITT (Consultative Committee for International Telephone and Telegraph) transmission performance requirements and will have higher reliability.

To accomplish these capabilities, this future generation of systems is based on a unique packaging of components and advanced technology -- optically amplified bit-rate insensitive repeaters, bit-rate sensitive terminal equipment, dispersion-shifted fiber, and cable. These components are briefly described as follows.

The bit-rate insensitive repeaters are being developed with a minimum of active components and are based on Erbium Doped Fiber Amplifiers (EDFAs) used in an optical amplifier unit. This optical amplifier unit is housed within the repeater casing. Erbium doped fiber is a special type of optical fiber doped with the rare earth element, erbium. When pumped with light, via a pump laser, in a specific metric range, the erbium fiber provides amplification for an optical signal. The pump laser, which is a semiconductor laser diode, produces the light providing the erbium fiber with the necessary energy for the erbium doped fiber to act as an optical amplifier. Since these optically-amplified repeaters have been designed with far fewer active components than regenerative repeaters, the likelihood and number of component malfunctions is reduced, thus, overall reliability of these systems will be increased.

As described earlier, the terminal transmission equipment of previous digital systems provides the interface at the 140 Mb/s (the CEPT-4 CCITT) standard interface rate between the local terrestrial network and the undersea cable system. To ensure compatibility with future international standards, the next generation of undersea system's terminal equipment will also support the 155 Mb/s (STM-1 CCITT Synchronous Digital Hierarchy [SDH]) standard interface. The number of such interfaces is dependent on the maximum optical line rate selected by the customer. That is, the maximum optical line rates are 622 Mb/s, 2.5 Gb/s, or 5.0 Gb/s. Thus, for example, a 622 Mb/s maximum line rate can support transmission capacities of either four (4) CEPT 4 (140 Mb/s) or four (4) STM-1 (155 Mb/s) signals per fiber pair. In addition, a mix of these two rates can be accommodated as long as the combined capacity does not exceed the maximum line rate.

Several types of previously proven AT&T SL cable including Lightweight, Armored and Special Applications cable will be used in these new systems depending on the ocean environment. These systems will also utilize Dispersion Shifted Fiber which is a special type of optical fiber. This type of fiber is required to mitigate the effects of fiber dispersion.

This combination of components and state-of-the-art technology will meet customers high volume traffic needs for voice, data, teleconferencing, television and other services at lower cost. The higher reliability is critical to those information-based companies requiring fast and accurate information transfer worldwide. Taking us through the 1990's and beyond, SL2000 systems are expected to be generally available in early 1995. And, as with any new technology, current experiments are showing promise for increased capacity, such as 10 Gb/s, and may provide for capabilities yet unknown and for services not yet imagined -- meeting the needs of the global market.

PACIFIC SCARAB ONE
DEEP WATER ACQUISITION, BURIAL and RETRIEVAL

by

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Abstract

The Pacific Submersible Craft Assisting in Repair and Burial, PACIFIC SCARAB ONE ™ (PS-1) is a fifth generation Remotely Operated Vehicle (ROV) designed specifically for underwater cable maintenance and repair operations. PS-1 established a new record for ROV's engaged in cable maintenance by performing full jetting and burial functions at 2684 meters. In addition, PS-1 was designed for launch and recovery in adverse sea conditions, up through Sea State 5. PS-1 incorporates the newest advanced work packages and specialized tools required to perform a wide variety of undersea tasks, such as cable sensing, object acoustic signature recognition and acquisition. PACIFIC SCARAB 1 is used for inspection survey, cable acquisition, maintenance and restoration of international communications in the Pacific and Indian Oceans and other select recovery projects. This paper discusses the ROV's design, functional capabilities and its performance criteria.

Introduction

The PACIFIC SCARAB ONE system represents the latest design specification for ROV's from Transpacific Communications, Inc. (a subsidiary of AT&T) and Teleglobe Marine, Inc. (a subsidiary of Teleglobe Canada). PS-1 is based in Astoria, Oregon and will provide cable repair and burial assistance for the North American Zone of the Pacific and Indian Oceans Cable Maintenance Agreement (PIOCMA). It will also be available for commercial applications and specialized recovery projects.

PACIFIC SCARAB ONE is the fifth in a series of submersible ROV's dedicated to cable work. Although PACIFIC SCARAB ONE is very different in design and vintage from SCARAB I, II, and III, they all provide the users with vehicles specially designed for cable acquisition and recovery. PACIFIC SCARAB ONE shares the basic design parameters of SCARAB IV, the major differences being their depth ratings and the speed and vintages of their computer hardware, software and electronics.

Pacific SCARAB ONE and SCARAB IV are both operated by TPCI. SCARAB III and IV are on stand-by in Vigo, Spain and Baltimore, Maryland respectively and they are dedicated to providing cable maintenance support to the Atlantic Cable Maintenance Agreement (ACMA). These vehicles are owned and operated by a five member International Consortium. SCARAB II is owned totally by AT&T / TPCI and is operated out of the Baltimore depot. It is available for a variety of uses, including ACMA assignments and commercial applications such as the recovery of the flight recorder for the Air India disaster.

The PACIFIC SCARAB ONE contract was awarded to OCEANEERING TECHNLOGIES, formerly Ocean Systems Engineering, in October 1990. After completing sea trials and final acceptance tests in Alameda Canyon in the Gulf of Mexico, PACIFIC SCARAB ONE was placed in Ready For Service status on June 1, 1991, and was officicially accepted as of July 15, 1991.

By exercising the multiple vehicle option of the SCARAB IV contract, and by utilizing its basic design, a major time savings associated with design was realized.

OCEANEERING TECHNLOGIES incorporated many of the SCARAB IV modifications implemented during Hawaii 4 Burial Project into the design criteria of Pacific SCARAB ONE, along with many new technology innovations. The major differences between the two vehicles are PS-1 incorporated addition operating depth requirements, improved system efficiency and additional power requirements. In addition, PS-1 design allows for the mounting of spe-

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cialized tool handling and delivery systems that were not included in previous vehicles.

Although the Pacific SCARAB ONE bid requirements included a burial depth of 0.6 meters at 300 meters per hour similar to the functional requirements which was delivered in SCARAB IV, experience has led to improvements in the jetting skid design takes the current state-of-the-art far beyond previous capabilities. These will be discussed in details in the Jetting and Excavation Skid portion of this paper.

PACIFIC SCARAB ONE 's specification represents the continued development and refinement directions for AT&T / TPCI's vehicles which demand the free flying maneuverability to negotiate wide ravines and canyons and cable suspensions.

PACIFIC SCARAB ONE Performance Design Criteria

The HAW-5 and TPC-4 cables that are planned for installation in 1992 and 1993 represent the latest evolution in fiber optic communications. With the advent of this new SL fiber optic cable used for international communications, service interruptions represent a major loss of revenue to a communications company.

Service interruptions on undersea cables are minimized as a result of burying cables in areas of high fishing activities, installation of armored cable in unburied sections, and cable protection education of sea bottom users. However, they do occur through trawling accidents, abrasive wear and other natural disasters such as undersea earthquakes and sea bottom slides. As a result of rerouting and satellite restoration capabilities, we are able to minimize outage effects. However, under the terms and conditions of the various cable maintenance agreements, we must retrieve and repair damaged cables in a timely and economical manner. Therefore, to achieve this goal, we must frequently undertake the acquisition, retrieval, repair and burial of a cable in less than ideal conditions. To enable us to meet these service demands, we incorporated stringent operating specifications into the design criteria for PACIFIC SCARAB ONE.

In an attempt to limit the time that PACIFIC SCARAB ONE would spend Waiting-On-Weather and to ensure it could operate under severe weather conditions, an extensive operating criteria was included in the design specification. The performance specification included items such as operational depth requirements, surface and bottom currents requirements, vehicle launch and recovery criteria and jetting and excavation requirements for a variety of soil compositions. As stated earlier, many of the design criteria evolved from operational experience gained while burying the HAW-4 cable off Pt. Arena, California in May and June of 1990 with SCARAB IV.

Since the PS-1 operating criteria and the design specification far exceeded those associated with previous vehicles, there were some increased costs. In certain areas, however, these were offset by using the SCARAB IV design and specification as a cost foundation for our new vehicle. For example, the extended depth capabilities required additional engineering and material costs associated with the umbilical and foam pack, however, the design time savings and packaging similarities of the two vehicles resulted in an overall savings benefit.

PACIFIC SCARAB ONE System Description

Because of the wide variety of work that has been proposed for PACIFIC SCARAB ONE, like its predecessors, PS-1 was designed with a modularized, self-contained system concept in mind. This allows for the rapid mobilization and demobilization required for installation on a wide variety of ships that may be assigned as a work platform in the Pacific Northwest. This varied deployment of PACIFIC SCARAB ONE on a vessel of opportunity must be accomplished within forty-eight hours. Therefore, an integrated subsystems approach is essential to the deployment of the vehicle configured for specialized tasks. The major subsystems of PACIFIC SCARAB ONE are:

- Remote Operated Vehicle and Seven Function Manipulators
- Jetting and Excavation Skid
- Underwater Tools
- Umbilical
- Umbilical Winch and Hydraulic Power Unit
- Launch and Recovery System
- Control and Observation Subsystem
- Generator Set

Remote Operated Vehicle and Seven Function Manipulator Subsystem

The PACIFIC SCARAB ONE ROV is an electro-hydraulically powered system developing 150 horsepower from its two 75 hp Franklin motors. The navigation suite, manipulator arms and the specially designed tool packages are all microprocessor controlled. Tightly packaged, with dimensions of 4m x 2m x 2.2m, and a weight of approximately 5.3 tons, the ROV can achieve forward flight at a speed greater than 4 knots. Most importantly, PACIFIC

SCARAB ONE has been proven to perform at 2500 meters and has been tested at 3000 meters to ensure a safety margin.

In spite of its size and weight, PACIFIC SCARAB ONE is designed to be positively buoyant and float proud in the water. The additional depth requirement, beyond that of SCARAB IV, resulted in additional vehicle weight due to greater crush resistance of various electronic canisters, the addition of the Enhanced Bottom Sonar System (EBSS), and additional umbilical length. Therefore, to meet the positive bouyance requirement redesign of the syntatic foam block was required.

The vehicle is equipped with two fore/aft thrusters, two lateral thrusters and four vertical thrusters. As a result of this propulsion configuration, PACIFIC SCARAB ONE has a higher degree of maneuverability than its predecessors and many smaller, lighter ROV's. Microprocessor controlled pitch and roll sensors and both long and short ranged altimeters, coupled with advanced flight control algorithms provide automatic control of heading, depth, altitude, and pitch and roll. The incorporation of this state-of-the-art automatic flight control and high quality computer graphic displays significantly reduces pilot fatigue and stress. Thus, the pilot can concentrate on the main mission objectives.

As a result of lessons learned from SCARAB IV, the tightly designed packaging and the strategic location of equipment reduce vehicle noise. PACIFIC SCARAB ONE is quieter in the water than any vehicle its size, including the other HYDRA based vehicles to date. It is even quieter than ROV's and RCV's (Remote Controlled Vehicles) that are much smaller and lighter, and its acoustic signature approaches RCV's using electric motors for propulsion. In addition, because PACIFIC SCARAB ONE uses highly sensitive magnetometers for object and fault location, this reduction in acoustic and magnetic signatures is essential for efficient cable tracking and object signature identification.

PACIFIC SCARAB ONE is equipped with two specially designed seven- function manipulators that can be configured for mounting either on the main vehicle or on the jetting skid, depending on the task at hand. These manipulators were designed with unique wrists capable of outputting 95 Nm of torque and each has the capability of lifting 150 kilograms at their fully extended reach of 1.5 meters. The mounting positions for the manipulators allows a wider degree of movement over that of SCARAB IV. A newly designed hydraulic tool delivery system, which presents the tools to the manipulators, adds increased flexibility. Because of its superiority over previous packages, it will be retrofitted onto SCARAB IV.

To allow the pilot and bridge supervisor to scan the vehicle flight path or to observe jetting or functions being performed by the manipulators, PACIFIC SCARAB ONE is equipped with five high definition video cameras, one of which is color. These cameras are equipped with hydraulic pan and tilt to provide the widest, and most clear field of viewing.

Jetting and Excavation Skid

Because the jetting and excavation skid is designed to bolt to the bottom of the PACIFIC SCARAB ONE ROV subsystem, it has been designed to provide neutral buoyancy. This is required to ensure the overall positive buoyancy of the ROV system. The skid has the same footprint as the ROV, 4 m x 2 m, and has a design height of 1.1 meters, including the floatation foam that mounts between the ROV and the skid. Since jetting and excavation are bottom activities, the skid is equipped with two parallel skis, thus allowing forward and aft motion on a wide variety of ocean bottom terrain.

To allow the burial or excavation of either a cable or an object for recovery, the skid subsystem is equipped with three pair of high volume, low pressure nozzles, three pair of low volume high pressure nozzles, and two excavation nozzles. Each pair of nozzles can be deployed independently by the operator to achieve the desired burial depths in a soil composition varying from loose sand to crusted bottom to highly elastic clay. As a result of burial operations on the HAW-4 cable, the original design was modified to provide addition protection for the cable if the jetting pressure forces the cable off the bottom, a protection block prevents it from jamming between the nozzles and the frame. Another design change now incorporates the same nozzle on the entire skid assembly, eliminating multiple sets of spare nozzles.

The excavation tools can be configured for operation at either the fore or aft of the vehicle. In areas that require large volumes of soil to be ejected, the forward excavation tools can be supplemented by a high volume venturi lift which is held in one of the seven function manipulators. This tool package was used effectively on the SCARAB IV HAW-4 Burial. Using the venturi vacuum we were able to evacuate significantly large pits required to bury loops and bows in cables. In addition, a quick connect firehose can be attached to one of the vehicle pumps if it is desirable to use a high pressure wash to blow away debris

from repeaters or to reposition soil under a minor suspension.

By the use of computer graphics and pull-down menus the pilot can select the proper nozzle deployment configuration based on soil type and determine the proper depth for jetting. The graphic display on the control console also provides visual data on the burial process. In addition, the camera mounted beneath the skid can be focus on the jetting and subsequent trench.

Underwater Tools

As previously discussed in the ROV subsystem description, PACIFIC SCARAB ONE is equipped with two seven function manipulators, which can be mounted on either the ROV or the jetting skid, depending on the task to be done. The manipulators can be equipped with specially designed tools for cable gripping and cutting, point burial or excavation and recovery scoops and baskets.

The two hydraulically activated cable grippers, which are part of the tool suite, can pick up cables as small as 2.58 cm and securely hold the cable in their jaws until the cable can be brought onboard ship for repair and splicing. Once a gripper is hydraulically locked on the cable, it is dropped from the manipulator, and a recovery line attached to the gripper is used to haul the cable from the ocean bottom to the ship. Once the crushed end of the cable is cut from the recovered cable, the gripper is hydraulically opened and can be reused. The cable end is "stoppered" to allow recovery.

The cable cutting tool is an intensified hydraulical powered system, and the cylinder actuated anvil is capable of cutting through 100 mm double armored cable.

Because of the dulling effect and stress caused by cutting armored cable, both the anvil blades and the anvil itself are easily replaced.

The point burial tool is a high volume, low pressure jetting nozzle that is deployed via the manipulator to bury or excavate in areas that are not easily accessible by the vehicle. As mentioned earlier, a high volume venturi vacuum lift can also be held by a manipulator for clearing larger areas.

Umbilical

PACIFIC SCARAB ONE uses optic fibers to communicate from the control console microprocessor to the microprocessors onboard the ROV. This duplex communication is handled via seven multimode optic fibers and three single mode fibers. One of these fibers is dedicated to serve as an EBSS calibrated link.

Power is delivered from the generator set to the vehicle over copper conductors. Both the fibers and copper conductors are encased in a contrahelically wound double armored umbilical. The engineered break strength of the umbilical is in excess of 30 tons, therefore it can be used for emergency recovery of the vehicle. Floatation devices are directly attached to the umbilical to keep it from lying on the bottom and to keep it suspended off the seabed out of the vehicle's path. The direct application of the football floats to the umbilical was found to be the desired methodology when SCARAB IV's umbilical management was compared to SCARAB III which attaches the floats to the umbilical with mountaineer knots. The use of flotation devices that encapsulate the cable prevents stress points that allow the heavy umbilical to kink. PACIFIC SCARAB ONE 's umbilical attaches direct to the winch and optical interface units without the use of a Tether Management System (TMS), therefore it can achieve a higher degree of maneuverability than a tophat system, especially when liveboating in shallow water.

Umbilical Winch and Hydraulic Power Unit

Because we mobilize PACIFIC SCARAB ONE on various ships that are available in the Pacific for cable maintenance and repair, deck space is often at a premium. To minimize deck space allocated for the umbilical winch and hydraulic power unit, these units have been configured vertically and occupy a single footprint. Because speed in mobilization is also critical, the winch frame incorporates ISO corners for rapid tiedown.

The winch is a drum type unit with a right angle, electronically controlled levelwind. The levelwind, smoothes the layers of umbilical as it is retrieved, thus eliminating cable pile-up.

The primary purpose of the winch is to retrieve the umbilical at a uniform rate and tension from deep water. However, as stated earlier, the umbilical is rated in excess of 30 ton lift capacity, therefore, the winch has also been sized to retrieve PACIFIC SCARAB ONE from the bottom in cases of "dead-sub" recovery. The winch subsystem is equipped with total redundancy, therefore either of the winch drive motors has the capability of lifting PACIFIC SCARAB ONE.

The hydraulic power unit (HPU) and the levelwind are mounted above the winch. The HPU supplies power to both the umbil-

ical winch and the constant tension winch, which is used for normal vehicle recovery. In an attempt to streamline component weights, hose size and pressure, a primary hydraulic pressure of 4/4 bars has been chosen as part of the engineering design criteria.

The design of the electrical system results in a configuration that prevents or minimizes component damage as a result of high voltage failure. The design calls for two sets of electrical slip rings. The high voltage slip rings are mounted on one end of the winch shaft, while the signal and low voltage slip rings are mounted on the other end of the winch shaft.

Launch and Recovery System

The PACIFIC SCARAB ONE launch and recovery system is comprised of an articulated crane, constant tension winch, swing frame and an overboarding sheave. The articulated or knuckle crane has a reach of eleven meters and designed to reach over the side of most ships to nearly the waterline. This capability allows PACIFIC SCARAB 1 to be lowered a very short distance into the sea, thus lessening the air-to-water-interface impact. It also increases our ability to launch in adverse seas and high wind conditions.

The constant tension winch is mounted on the first knuckle of the crane and is responsible for keeping a constant tension on the recovery line during launch and recovery sequences and during the vehicle power-up sequence and thruster testing. During these sequences that demand high recovery line control, the constant tension winch has the capability of feeding in and paying out up to 90 meters of SPECTRA 12 line per minute.

The swing frame is equipped with a disk brake assembly to dampen swing motion of the vehicle while PACIFIC SCARAB ONE is in the air during launch and recovery. In addition, the swing frame is equipped with air shock absorbers to lessen the impact between the swing frame and the ROV's floatation foam during the latching procedure, prior to vehicle lift. The male or positive latching mechanism which is terminated to the end of the SPECTRA 12 line is considered part of the swing frame subsystem. Because of the severe conditions experienced on the West Coast and the additional weight associated with PS-1, the latching mechanism has been designed to reduce stress on the vehicle attach point.

Crane motion - extend, lift, knuckle-in and knuckle-out - as well as the operation of the constant tension winch and latch mechanism is controlled from the crane operator position mounted on the base of the crane pedestal.

Control and Observation Subsystem

The PACIFIC SCARAB ONE control and observation subsystem is divided into four primary stations: the control van, supervisor's center, portable bridge and belly-pack controls for the ROV and umbilical winch, and the remote observation center.

The control van is effectively the brain of the PACIFIC SCARAB ONE system because it is here that the AT&T 6486 Star Server S System and the Hewlett-Packard computers that control the all electronic and hydraulic functions are located. These computers are responsible via optic fiber links for communication with the microprocessors that control the ROV's electrohydraulic functions and the umbilical winch.

In addition to video displays that are linked to each of the ROV's five cameras, there are multiple computer graphic displays to aid the pilot and the tools operator in remotely controlling and manipulating a complex integrated system.

It should once again be pointed out that the use of multiple cameras allow the pilot and the bridge supervisor to have better points of observation for the descent/assent mode or while jetting. In addition to the twin Sony monitors mounted in both the pilot's and the tools operator's consoles, each has a 20-inch Sony high definition monitor that can be used to display images from any of the cameras. The consoles also contain graphic displays that incorporate graphic data such as depth, attitude, pitch, nozzle deployment, thruster activity oil compensation pressure, acoustic signatures of cables and other objects and cable tracking data. There is a second graphic display that tracks position of the vehicle in relation to the ship. This acoustic positioning system also displays other proprietary information important in our cable acquisition and retrieval efforts.

This system represents state-of-the-art computer graphics to control all functions, utilizing a track ball to activate selections from pull down menus. Banks of switches and gauges have been eliminated from the control center in favor of the computer graphic displays and menus. Operator diagnostics and alarms are also graphically displayed. System setup, calibration, troubleshooting and operations are all controlled from the computer graphics console in the control van.

The supervisor's center is located on the ship's bridge during acquisition and recovery missions. The displays in the supervisory console are duplicates of many already located in the control van. However, the lack of ROV command control in the Supervisory Center is the significant difference, even though both centers display identical pull down menus and diagnostic graphics. The supervisor's center includes two Sony display monitors that can receive video input from any of the PACIFIC SCARAB ONE cameras, and two acoustic positioning system monitors, one of which is positioned for viewing by the ship's quartermaster while at the helm, and a pen plotter for output plots of navigational data.

PACIFIC SCARAB ONE's navigational system represents a complex integration of navigational data inputs from the cable tracking magnetometer system, the acoustic positioning system and the ship's navigation input. The ship's navigational input is dependent on the ship on which PACIFIC SCARAB ONE is mobilized, and may be manually calculated, based on Loran SEA output, or be obtained from either the Global Positioning System (GPS) or the Dynamic Positioning System (DPS). All inputs are integrated in real time to give an extremely accurate bottom positioning for the vehicle. During the Hawaii 4 Burial Project, shore mounted trisponders were also used in conjunction with the DPS. This allowed the ship to be located very close to the plotted cable location. This ensured that the cable acquisition effort was reduced to a minimum time.

The PACIFIC SCARAB ONE portable bridge pack and the belly-pack controls for the ROV and the umbilical winch provide remote controls for both subsystems. These units can be located on either bridge wing, or any other high point on a ship that will provide the best view of the ROV on the water surface for the launch and recovery sequences. Locations other than the control van or the the supervisor's center provide the advantage of watching the position of the ROV in relation to the ship's hull and for for observing actual air-sea interface. The belly-pack, like the bridge pack, also includes a communication link to the control van, the supervisor's center, the remote observation center and the crane operator's position.

The remote observation center, like the control van and supervisor's center contain video monitors, a video recorder and a video typewriter for annotation. This center is for non- critical personnel - those not involved in the system control and operation - who desire to observe and record a project. Personnel at this location do not have the option of selecting the video input displayed on their own; the camera input desired must be requested from the operators in the control van who will switch in the desired video input.

Generator Sets

PACIFIC SCARAB ONE 's power requirement is 2300 VAC, 3-phase at 60 Hertz. Because of this high power demand, PACIFIC SCARAB ONE incorporates two diesel generator sets in its design to eliminate dependency on ship's power. Each of these generators are capable of assuming the full power requirement for PS-1, thus providing the redundancy required for emergency situations. Another reason for supplying generators as part of the PACIFIC SCARAB ONE system is that many of the ships available are of foreign registry, and their power plants are 50 Hertz. In addition, their plants may not be sized to provide the demand on isolated circuits without major plant modification.

Conclusion

PACIFIC SCARAB ONE represents the 1991 view for the current state- of-the-art ROV design, computer graphic flight control and diagnostics as well as seven function manipulator robotics. In addition, the same claim can be made for the cable location and tracking system.

This ROV is equipped with an AT&T Enhanced Bottom Sonar System (EBSS) which is an acoustic signature identification system that can switch between parametric and linear sonar. EBSS has a bottom penetration of 3 meters to allow for cable or object location and bottom profiling. EBSS is designed to operate at depths up to 6000 meters. In September 1991, 26 uncontested patent claims were granted to AT&T for EBSS. Features and capabilities of EBSS were presented at the OCEANS'91 Conference also held in Honolulu. EBSS is an AT&T Standard Product from the International Submarine Maintenance organization.

AT&T / TPCI and TMS are dedicated to protection and maintenance of Pacific Undersea Cable Systems. And, PACIFIC SCARAB ONE and its Atlantic predessors, will continue to evolve with the application of new and leading edge technology. AT&T International Communications Services is dedicated to providing quality communications service worldwide.

This same dedication and skill level is applicable to any commercial ventures for PACIFIC SCARAB ONE. TPCI will operate this ROV with only highly experienced personnel to guarantee mission success.

AT&T Submarine Systems, Inc.
Non-Repeatered Product Overview

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AT&T Submarine Systems Inc. (SSI) Non-Repeatered Product combine Terrestrial Terminals with Submarine Lightwave Cable Technology to provide a full range of Voice, Video and Audio Teleconferencing Data and Wideband Services.

As the demand for telecommunications facilities has increased world wide, AT&T Submarine Systems, Inc. is becoming recognized as the Market Leader in the supply of Turnkey Fiber-Optic Submarine Cable Systems. Leading the International field in the system planning, engineering, installation, maintenance and overall end to end support for undersea submarine cable systems. AT&T's milestones in lightwave technology began with the successful installation of the Optican-1 system, the world's first commercial repeatered deep sea lightwave system, installed between Tenerife and Gran Canaria in the Canary Islands in September, 1985. The completion of the TAT-9 system in October 1991 was AT&T's first system using the SL560 mbps technology. It spans 4,652 Kilometers and consists of 42 Repeaters. Undersea cable systems that require the use regenerative technology (repeaters) has steadily increased. This is also true for systems that do not require repeaters, the Non-Repeatered Submarine Cable System.

Non-repeatered systems are steadily becoming the preferred telecommunications solutions to connect two terrestrial locations separated by a body of water without the need for regeneration or amplification of the optical signal. The capacity or bandwidth requirements are readily upgradeable in a non-repeatered system since there is no undersea plant (repeaters) involved. Upgrading of the terrestrial terminals will provide additional capacity to the same installed cable as the traffic demand increases. The primary application for non-repeatered systems exists in the National market typically defined as extensions of existing terrestrial networks, versus the international market where repeatered systems typically are required. These applications:

1. Mainland to island links
2. Island to island links
3. Coastal loops
4. Crossing large bays or rivers
5. Mainland to offshore installations (e.g., oil platforms)

AT&T's first non-repeatered system known as TAIPN 1 was installed in August of 1988. It connected Tainan and Pengh-Hu in the Taiwan Strait and consisted of 104 km of cable and terrestrial terminals with a capacity of 417 mbs. In 1991 AT&T was awarded the Qualo, Chemlu and Cameron Lakes system consisting of 167 kms of cable as well as the Taino-Caribe system consisting of 186 kms of cable and terminals with a capacity of 565 mbs. To meet customer's requirements for increased span lengths in the non-repeatered marketplace, AT&T Micro Electronics has developed, with the expertise of Bell Labs, a Fiber Power Amplifier Booster Module (FABM) using Erbium Doped Fiber Amplifier technology. When combined with terrestrial terminals, longer span lengths can be achieved. In addition the FABM can also be used to overcome dispersion problems should they exist. The FABM is designed as an optical interface for a 622 mb/s or 659 mb/s lightwave terminal. The FABM extends the transmission range of North American/Sonet and CEPT/SDH terminals to the maximum non-repeatered span lengths possible, while preserving terminal features and functionality.

AT&T-SSI has also recognized the need for lighter weight, easier to install undersea cable. To this end, AT&T-Bell Labs has designed a new cable type specifically for use in non-repeatered undersea cable systems. This new design, much like our SL cable design, used in repeatered systems, has the same 25 year life expectancy and is comparable in strength and robustness as our traditional SL cable. The cable consists of an SL Unified Fiber Structure (UFS) containing up to 12 optical fibers, a

strand package with 16 high strength steel wires, a copper sheath and a plastic jacket. The SL polyurethane waterblocking compound used, protects the cable from water ingress. This new cable design, available unarmored, single or double armored, can be buried and recovered from the ocean bottom should a repair be required.

The key technical requirement for Non-Repeatered Systems is increased span length while maintaining systems' margins. With the combination of the Fiber Amplifier Booster Module, developed by AT&T Micro Electronics, terminals from AT&T Network Systems, fiber options such as Dual Coat Germanium Doped, Silica Core and Dispersion Shifted Fiber and AT&T's new cable design, AT&T SSI is here to meet and hopefully exceed your expectations. It has been our experience that each customer is unique in its requirements for a non-repeatered undersea cable system.

Our years of experience in planning systems with our customer provides high reliability maintenance, installation, training, on time delivery, as well as our expertise in marine operations, positions AT&T Submarine Systems as a value added end to end supplier of both repeatered and non-repeatered undersea cable systems.

THE ALOHA CABLE: A NEW SELF-RESTORING, HIGH CAPACITY CABLE WITH SONET

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1. ABSTRACT.

There is a substantial need to increase the resilience of high capacity undersea cables to man-made disruption. In addition, there is a critical need to increase the capacity of digital transmission facilities between Hawaii and the U.S. mainland. The Aloha cable meets each of these needs with a new self-restoring design and by employing STC Submarine Systems' evolutionary 2.5 Gbit/s SONET-standard cable design. The result will be the world's largest, most reliable undersea fiber optic cable by the end of 1993!

2. INTRODUCTION & BACKGROUND.

Although advances in undersea fiber cable technology appear to be heading in a fairly well defined, straightforward path, in fact progress is much more complex. As we devise larger and larger capacity systems, the changes in the process by which we operate these systems is analogous to the change in passenger handling arising out of the introduction of very large jet aircraft. Loading three or four hundred people and their baggage on one vehicle in reasonable speed and comfort requires a different approach to loading fifty to a hundred people on a plane. Similar changes can be seen in the new Aloha Cable system.

Transnational Telecom (TTL) of Washington, D.C. is constructing the Aloha submarine fiber optic cable between Oahu, Hawaii and Oregon. STC Submarine Systems (STC), a division of Northern Telecom, is TTL's turn-key contractor for the system. The Aloha Cable will employ STC's NL 16 2.5 Gbit/s SONET undersea cable technology capable of over 32,000 simultaneous uncompressed telephone calls. When operational in late 1993, the Aloha Cable will be the highest capacity submarine cable in the world and will represent two firsts: employment of SONET technology and a new self-restoring design. As a system, its technical interest is therefore not confined to its high bandwidth but also in other features that its configuration offers.

3. ALOHA: KEY FEATURES.

Four key features of the Aloha Cable system are:

1) Self-restoration.

2) High bandwidth, 2.5 Gbit/s capacity.

3) SONET standard transmission.

4) Standard terminal equipment.

These key features are described below:

3.1 Self Restoration.

Fundamental to any network planning is the need to be able to restore a link in the event that use of the system is denied to the network operator. When a cable system is unavailable, the most common method of restoration has been via satellite. However, developments in recent years have made this an increasingly difficult option. In the first place, an increasing number of users prefer cable for their data/voice transmission path and this has generated demand for cable on cable restorations. Secondly, the rapid increase in the bandwidth of cable systems is making it impractical to restore by satellite because the bandwidth necessary is simply not economically available.

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In network planning terms the solution is increasingly seen as the use of a ring configuration for a submarine cable system. A ring has the elegant simplicity of always offering two routes between any two points on the ring and therefore a cable break can be restored by the simple process of "going the other way around". This concept has recently been incorporated into the planning of new cable systems in both the Pacific and the Atlantic. However, this is for the second half of the decade and since it involves, in effect, two completely separate cable systems, it is an expensive solution to the problem. The Aloha cable system has been designed to provide the restoration capability of a complete ring next year without the high associated costs.

An analysis of the causes of cable failure indicates that there are two types which have to be guarded against. One is electrical failure, which is uniformly likely to happen anywhere in the system. The other is a cable strike severing or damaging the cable and making the whole cable unusable. This is usually the result of fishing activity or the dragging of an anchor. This latter type of failure is almost wholly confined to the shallow water sections of the cable route.

a) Electrical Failure.

All submarine fiber optic systems of any length have built-in protection against electronic failure. This in its simplest form is provided by redundancy of the components most likely to suffer failures. However, greater security has been provided in most transoceanic systems by means of a spare line.

The system being employed in Aloha allows the traffic to be switched from one fiber pair to the other at a repeater. The system would, therefore, be capable of coping with a considerable number of electrical failures (in the unlikely event that this was necessary). It is worth noting that very few systems of the length of Aloha or longer have had the confidence not to employ a spare line. One of the consequences of the high rate of technology change in the optical submarine cable business is that one generation of technology rapidly follows another. Although Aloha will go into the water next year with a transmission line rate of 2.5 Gbit/s, there is at this stage less than six months of underwater experience with any commercial system using the 1.5 micron lasers designed into all submarine fiber systems operating at line rates of 560 Mbit/s and above.

b) Physical Failure.

The risk of physical damage to the cable is generally confined to the shore ends at water depths of up to 1500 meters. The Aloha Cable system overcomes this problem by offering a duplicated shore end construction at each end with the two "branches" linked on land and remotely switched at a branching unit in relatively deep water (about 1500 meters depth). Thus there is always a standby cable available in those portions of the cable route where there is a risk of mechanical damage. The two shore ends are linked together terrestrially and thus it can be seen from Figure 1 that the Aloha Cable system is in effect a ring system in which both deep water parts of the route are contained within one cable casing. The ring itself is completed by interconnecting the twin landing points via the Aloha terminal office or point of presense (POP) as part of the ring.

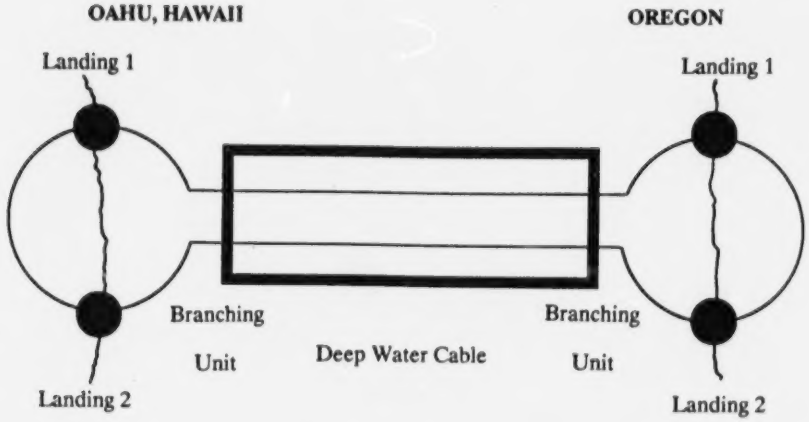
It could be suggested that there is still a higher risk as a result of the single physical connection between the two branching units. However, it must be stressed that: firstly, physical damage to the cable in deepwater is extremely rare and secondly, that the probability of an event which would take out both shore ends is, if anything, greater than the probability of the deep water break. Extending this argument, the risk of a ring system being unable to restore itself is extremely small and the exact configuration of the deep water portion of the ring has little impact on the probability of an outage.

c) Repair Outage.

It has been suggested that in the event of a cable break it would be necessary to de-power the whole system before repairing the damaged leg thus reducing the effectiveness of the duplicated landings. The latest developments in marine repair techniques have overcome this problem. Late last year a fault occurred in the French leg of TAT-8. This fault was repaired without the necessity of taking the US-UK leg out of service. This is in contrast to the earlier repairs on the French leg in 1988 when the system had been de-powered following the old maxim "put not your trust in switches".

To avoid the hazard to the operators of the cableship occasioned by attempting to repair a damaged spur, it should be noted that the voltage at the branching unit can be reduced to zero. With Aloha it is possible to adjust the power feed at each end of the cable using positive and negative voltages so that the voltage is zero at the branching unit connected to the leg with the outage. By grounding the shore end of that leg, then, both ends of that leg, and thus the whole of the leg is grounded during a repair. This is reinforced by the power relay being switched away from the line current. As a final protection, it is now possible to grapple for a cable and provide a satisfactory ground

Figure 1. ALOHA SELF-RESTORATION.



before the cable leaves the water. Thus, the cable is brought aboard the repair vessel already grounded and procedures have been established to attach a more permanent grounding to the system before work is started upon it.

3.2 Gigabit Line Rate.

The congruence of the technical ability to perform a large number of functions and therefore provide a wide range of services over telecommunications networks, together with a worldwide political climate which is allowing - indeed encouraging - a more open and competitive environment in telecommunications has led to an explosion in the demand for bandwidth. Thus, within four years of the first digital optical transoceanic system going into the water, we have moved through three generations of undersea fiber optic technology: 280 Mbit/s at 1.3 microns, 420 Mbit/s at 1.3 microns and 560 Mbit/s at 1.5 microns. Typically, as the first model of one generation goes into the water, the next generation is ready to move out of the lab and into production. At this stage, however, it becomes an interesting debate as to which is the next step forward in optical technology. In terms of wavelength, there is nowhere to go at present beyond 1.5 microns. In terms of bandwidth the next logical step is an increase of either one or two octaves and the general view is at this stage two octaves are needed. The open question is the technology which will be used to realize the first generation of Gigabit systems.

Optically amplified systems have been under development for some time. Although there is no question that the optically amplified system is the system of the future, it is not necessarily the system of the present or even the near future.

Conceptually the optical amplifier is the answer to the submarine cable planner's prayer. In the early days, the vision was of an optical pipe transparent to bit rate so that as the demand for bandwidth grew it was merely necessary to change the terminal equipment to upgrade the system. However, as usual, life is not that simple. The process of converting the optical amplifier from a concept to a reality has thrown up a number of problems which need to be resolved. For example, it is proving difficult to concatenate enough optical amplifiers to make a transoceanic span at an economic line rate. The dream of the optical pipe is tempered by the reality that an optically amplified system bandwidth is dependent upon repeater spacing. An upgradeable optically amplified system will therefore have to be planned and designed as such and thus will be more expensive than a non-upgradable system.

Two or three years ago, it was anticipated that transoceanic optically amplified systems would be installed in 1994. The latest forecast for the optically amplified TPC-5 system in the Pacific is for completion well into the second half of the decade. The implications of this can be seen by the HAW-5 cable consortium proposing to use its backup fiber pair for traffic growth instead of using it as designed for protection since, other than Aloha, the next increment to Hawaii-mainland capacity is dependent upon implementation of the still developmental optically amplified technology.

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Thus, although the optical amplifier remains the system of the future, it unfortunately still is the system of the future, while the need for higher bandwidth grows inexorably. Thus, it is now clear that there is a need for a generation of regenerative repeater systems operating at 2.5 Gbit/s. Aloha will be one of these. The use of a regenerative system for Aloha is conditioned by the recognition of the need for extra capacity next year and the fact that with the short optical amplifier spacing currently predicted at 2.5 Gbit/s, a regenerative system is a more economic solution on the longer term.

STC Submarine Systems' NL 16 system has been in development since 1989 and moves from the laboratory into production shortly. The system is in an evolutional development of STC's 280, 420, and 560 Mbit/s systems with new components and techniques necessary to accommodate operation at 2.5 Gbit/s. Although a new laser, a new detector and a new silicon process are being deployed, the component development is far less fundamental than the developments associated with optical amplifiers. Likewise, the system development is modest compared with the system development associated with the first generation of optically amplified systems.

3.3 Synchronous Transmission.

Traditionally, submarine cable systems have been designed to have a 25 year life. In this respect, the Aloha Cable and its NL 16 technology is no exception. However, when we consider that the last coaxial analog transoceanic submarine cable system went into service in 1987, and therefore has a physical life expectancy to 2012, it is clearly necessary to make as much effort as possible to protect against changes in the future to the extent possible. In three years time it will be 1995 and we will be calling for 20/20 vision to see what we need over the lifetime of our systems.

One of the earliest contributions to the need of 20/20 vision forward rather than backwards is the designing of the system as a synchronous networking transmission system. Synchronous Optic Networking (SONET) standard transmission facilities are beginning to be implemented by U.S. common carriers in their respective networks. The introduction of SONET into the U.S. network will provide the basis for broadband switched networking by the mid-1990's and form the foundation upon which broadband ISDN is implemented for the second half of the decade and beyond.

As a result, although we do not envisage a significant requirement for SONET transmission next year, it is envisioned that it will be a necessary requirement very early on in the working life of the system. Recognizing that operators will expect to have most of their networks configured in synchronous mode during the lifetime of the system, Aloha's NL 16 system has therefore been designed to be a SONET system from the outset with the ability to handle either plesiochronous (e.g., DS-3) or synchronous traffic (e.g., STS-1). For the purchaser of capacity in Aloha there will be the option of DS-1, DS-2, DS-3 or SONET STS-1 or STS-3 interfaces together with the option to convert from a plesiochronous input to a SONET standard input at any point in the future.

3.4 Terminal Equipment.

Traditionally, repeatered submarine cable systems have had custom designed terminal equipment which handled the multiplexing and line interfacing. For the Aloha NL 16 system, TTL's supplier, STC, has adopted a new approach. The system will be based on standard terrestrial transmission equipment, in this case the Northern Telecom OC 48. This is being augmented by a line interface equipment which will convert the output of the OC 48 into a 24B1P line code with the corresponding increase in line rates. This will allow the supervision of the system to be carried out outside the overhead of the synchronous system. It also gives the opportunity to allow Synchronous Digital Hierarchy (SDH) terminal equipment to be used where the user's requirement is for a CCITT compatible system as opposed to a North American SONET-based system.

4. SYSTEM DESCRIPTION.

The Aloha submarine fiber optic cable system will transverse the Pacific Ocean between Oregon and Hawaii. The system will operate at a SONET standard OC-48 (2.488 Gbit/s) channel transmission capacity although the actual rate over the cable will be at 2.592 Gbit/s in order to accommodate the submarine cable's supervisory system as described in the previous section.

The system is such that a single fiber pair (each fiber of the pair operates in the reverse direction of the other) operates at 2.5 Gbit/s end to end to provide the OC-48 optical channel. The OC-48 channel will then be converted at the Aloha terminating facilities to electronic signals and mux'd down to lower data rate digital signals.

Throughout the system, on every cable path, there will be a complete redundant fiber/regenerator path which will be switchable on a section by section basis to allow remote replacement of any failed section. In addition, at a location at 1500-2000 meters in ocean depth, a branching unit will be placed. From the

location of the branching unit through shallower waters to the shore, two identical cables will span, each to one of two widely spaced landing stations. The landing stations will be interconnected through the respective Aloha terminal stations at each end of the system. Each branching unit will be remotely switchable such that either leg or branch may be employed at any given time.

The Aloha Cable will span a distance of about 4500 km. It will be comprised of about 4800 km of cable, 62 regenerative repeaters, two underwater branching units and four landing stations, two on each end. The landing stations will each contain terminal equipment for the submarine portion of the system, interface equipment for the terrestrial fiber, system supervisory equipment, and redundant generator and uninterruptible power supplies to allow seamless operation in the event of commercial power failure.

The two Oregon landing stations will connect to terrestrial fiber facilities to interconnect the submarine system to Aloha terminating facilities in Portland, Oregon. Similarly, the two Oahu landing stations will interconnect with terrestrial fiber facilities which will interconnect the submarine system to Aloha terminating facilities in Honolulu, Hawaii.

TTL will interconnect with its customers, common carriers and others, at the respective terminating facilities in Portland and Honolulu. Interconnection will be at the DS-1, DS-2, DS-3, STS-1, or STS-3 level depending upon individual customer needs. TTL will also have the ability to extend beyond the terminating locations by interconnecting customers to other submarine cable systems in Hawaii and in the Oregon area as well as extending terrestrially to other locations.

5. SUMMARY.

The Aloha Cable represents a significant opportunity for common carriers to secure capacity in a high capacity digital system at a time when capacity is in short supply between the continental U.S. and Hawaii. By offering a SONET standard system, TTL is giving its customers the opportunity to use a hierarchy which is likely to be standard over most of the 25 year projected life of the system. By implementing the self restoring architecture, TTL is giving an answer to the problem of what to do if a fault occurs, enhancing the availability of the system significantly.

The Dynamically Changing Regulatory Climate for Foreign Investment in United States Telecommunications Companies

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1. ABSTRACT

In response to the extraordinary interest in recent years by foreign nationals from the Pacific Rim and other countries in investing in the United States telecommunications industry, this paper identifies and discusses United States statutory and regulatory restrictions on foreign ownership of United States telecommunications facilities, and how best to structure arrangements consistent with that regulatory scheme. While most restrictions are intended to ensure that control of such facilities remains in the hands of United States citizens, certain regulations are intended to provide information and leverage that may help to minimize discrimination against United States common carriers in foreign markets. The article suggests ways of facilitating foreign investments that do not contravene U.S. ownership restrictions, and also notes recent indications that certain agencies of the United States Government may now be reasonably receptive to considering relaxing some or all of these ownership restrictions, at least to the extent of affording reciprocity to citizens of other countries that allow open market entry by United States firms. Given the increasing receptivity of some governmental offices to allowing greater foreign investment and favorable timing for such investment, we suggest various ways of facilitating arrangements between foreign entities and U.S. telecommunications companies.

2. INCREASED INTEREST BY FOREIGN FIRMS IN ENTRY INTO THE UNITED STATES TELECOMMUNICATIONS MARKET

In the past several years, foreign nationals and firms have become increasingly interested in investing in United States telecommunications companies. For example, Cable and Wireless recently agreed to acquire TRT/FTC, a leading international data and voice carrier, and British Telecom has acquired a significant interest in McCaw Cellular Communications Inc., one of the United States' largest cellular telephone system operators. Foreign telecommunications administration from a number of European countries have already or are rumored to be making significant U.S. telecommunications investments. Moreover, private companies, such as Swissair, not primarily known abroad for their communications interests, have also invested in U.S. telecommunications firms. More recently, much interest among non-U.S. companies and foreign governments has been generated from the Pacific Rim area. The acquisitions of interests in U.S. firms with motion picture studios, such as Sony's acquisition of Columbia Pictures, and Matsushita's acquisition of an interest in MCA, Inc., have made headlines. The most recent of these investments to receive substantial public attention was C. Itoh's and Toshiba's investment in the Time-Warner media conglomerate.

As Rupert Murdoch's much-publicized exchange of Australian for U.S. citizenship to permit U.S. media acquisitions demonstrates, however, the nature and scope of many of these investments is substantially affected by United States laws and regulations restricting ownership of communications firms.(1) Acquiring a significant interest in a United States telecommunications carrier has consequences that are materially different from those of investing in most other U.S. properties, as well as from those of investing in foreign telecommunications entities.

Foreign ownership and investment in the operations of a U.S. carrier triggers a wide variety of federal statutes, Federal Communications Commission ("FCC") rules, and other restrictions whose impact largely turns on the nationality of the purchaser and the scope and nature of its operations abroad. Moreover, given various recent regulatory, tax, and international trade developments, this area of the law is undergoing significant change and reexamination both in the U.S. and abroad.

Based on our recent first-hand participation in negotiating and arranging for foreign ownership of U.S. telecommunications properties involving a variety of different nationalities, this article sets forth and comments upon the regulatory scheme affecting U.S. investments by foreign commercial interests and foreign entities. The paper traces the background of

the alien ownership restrictions of the 1934 Communications Act, as it applies to radio licensees, satellite and microwave carriers, and broadcasters, and highlights indications that the regulatory environment may become more receptive to at least reciprocal relaxation of current ownership restrictions. Finally, the paper not only identifies many of the significant ownership restrictions, but also discusses a variety of corporate/financial structures and regulatory strategies to mitigate or circumvent the seemingly inflexible statutory restrictions and bans of the 1934 Act and promote arrangements between foreign investors and U.S. telecommunications firms.

3. RESTRICTIONS ON FOREIGN OWNERSHIP OF TITLE III RADIO LICENSEES

3.1 ORIGIN OF AND OPPORTUNITIES FOR CHANGES IN OWNERSHIP RESTRICTIONS

As a general matter, foreign ownership of firms holding radio licenses (including such authorizations as radio broadcast, microwave, satellite, and cellular licenses) regulated under Title III of the Communications Act(2) is much more restricted than is the ownership of firms holding non-radio authorizations. The ownership of broadcast station licensees is the most heavily scrutinized, and ownership of holders of common carrier authorizations is more restricted than ownership of holders of private carrier authorizations.(3)

The current restrictions are the result of a statutory prohibition included in the Communications Act. The antecedents of these restrictions were included in the Radio Act of 1927,(4) for, following World War I, fear of use of radio in aid of espionage or sabotage by a potential enemy led to imposition of the original restrictions on foreign ownership of radio facilities.(5) Interestingly, this statute, designed to prevent espionage and sabotage during war at a time when communications was in its infancy, and few carriers existed, has been stretched virtually beyond recognition to bar many foreign investments in today's highly competitive high technology concerns, even by the most loyal allies of the U.S. Very recently, however, Bush Administration officials and other U.S. regulators have begun to give serious consideration to relaxing these restrictions. The FCC's Chairman Sikes, for example, has spoken out against "parochialism" in U.S. and foreign regulatory processes and has made a commitment to "building international relations among communications policymakers."(6) Chairman Sikes is also on record as stating that "protectionism is self-defeating," and went on to say not only that the statutory ownership restrictions "date back to another technological and commercial era," but also that the FCC and the Bush Administration "strongly support open international investment with very limited national security exceptions."(7) Similarly, Assistant Secretary of Commerce, Janice Obuchowski, Administrator of the National Telecommunications and Information Administration, and the Bush Administration's spokesperson on telecommunications issues, has recommended that the U.S. consider easing restrictions even on foreign ownership of U.S. broadcast outlets.(8) (Nonetheless, it should be noted that Chairman Markey of the U.S. House of Representatives' Telecommunications Subcommittee and others have recommended expanding the coverage of the statutory alien ownership restriction to cover cable television and certain other new technologies.)(9)

At this time, it is therefore critical for potential foreign investors not only to be cognizant of the scope of U.S. ownership restrictions, but also to monitor the U.S. regulatory environment closely so that they may identify significant potential changes promptly and consider appropriate responsive actions.

3.2 SCOPE OF OWNERSHIP RESTRICTIONS

Under the current regulatory scheme, the only absolute restriction on foreign ownership of U.S. radio licensees applies only to foreign governments. Specifically, Section 310(a) of the Communications Act prohibits a foreign government, or its representative, from holding any radio license. This prohibition applies even to a private radio license, and it is the only statutory prohibition that does apply to private radio licenses. Thus, in the satellite radio context, the FCC recently scrutinized an applicant's partnership documents to determine under Section 310(a) that foreign government investors had no control of a private satellite system applicant.(10)

The other statutory restrictions, however, do not impose a complete ban on foreign investment in radio licensees, and are inapplicable to interests in private radio licensees. Section 310(b) of the Communications Act prohibits a broadcast, common carrier, or aeronautical en route or aeronautical fixed radio license's (but not a private radio license's) being granted to or held by a corporation (1) having an officer or director who is an alien or a representative of an alien; (2) organized under the laws of a foreign country; or (3) having 20% or more of its stock under foreign ownership or control (that is, owned or voted by one or more aliens or foreign governments, or their representatives, or foreign corporations).

Under a related statutory provision, however, a foreign investor may acquire a somewhat larger interest, so long as it is held indirectly. Under Section 310(b)(3), and subject to the discretion of the FCC, a tiered ownership structure may be utilized to allow this greater indirect foreign ownership. Thus, the FCC may issue licenses to a corporation controlled directly or indirectly by another corporation where non-U.S. citizens comprise less than 25% of the parent company's board of directors, and less than 25% of the parent company's stock is

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foreign-owned. The parent company may not, however, have an officer who is not a U.S. citizen.

This discretionary indirect ownership "safe harbor" provision has also been applied to insulate certain foreign-owned partnership interests. In such cases, for purposes of analogizing partnership interests to corporate counterparts specified in the statute, general partners are treated as corporate officers, although limited partners may be treated as corporate shareholders if their ability to participate in partnership activities is sufficiently limited under specific Commission standards.(11)

The Section 310 requirements, being statutory, are very strictly applied. Thus, publicly-traded U.S. communications firms must have their stock transfer agents closely monitor levels of foreign holdings. Matsushita's acquisition of MCA, Inc., also illustrates the impact of the statutory restrictions, for the New York City television station owned by an MCA subsidiary had to be spun-off prior to the completion of the corporate acquisition to avoid violation of the foreign ownership limitations.

3.3 PERMITTED INVESTMENTS IN COMMON CARRIER AND BROADCAST RADIO LICENSEES

The potential foreign investor does, however, have a number of avenues for investing in U.S. firms holding radio licenses. With respect to broadcast or common carrier firms, as suggested above, a two-tiered corporate structure is the most common investment vehicle for increasing foreign participation. Frequently, a U.S.-incorporated holding company is formed to be the parent of the license-holding operating subsidiary to ensure that there is at least one corporate tier between the foreign ownership interests and the telecommunications licensee. Because the foreign ownership interest in the licensee's stock (voting and non-voting) is indirect, it may reach the 25% level, and non-U.S. citizens may hold 25% of the seats on the board of directors of the holding company parent firm.

In some cases, it may be possible to obtain a waiver of this ruling from the FCC if a higher level of foreign investment is desired. For example, in one recent case, the FCC found that an indirect interest of 26.6% represented a *de minimis* extension above the benchmark.(12) In the same case, however, the FCC deferred action on the applicant's request to be permitted to have indirect alien ownership of 49.9%. Thus, the FCC might be open to considering a 30% foreign indirect interest, particularly in a common carrier facility, but is likely to be less receptive to considering interests that approach the *de jure* control level.

In ruling requests, the FCC will consider a number of different factors, including:

1. Whether the foreign parent company is publicly held;

2. Whether the ownership interests are held by foreign governments;

3. The percentage of alien officers and directors;

4. Whether the licensees are common carrier rather than broadcast licensees, and thus do not have an opportunity to initiate or control transmission content;

5. The degree of the licensee firm's need for working capital;

6. Whether the investment facilitates participation by the U.S. firm in ventures abroad or assists it in obtaining foreign operating agreements;

7. The relationship of the foreign owner's domiciliary country with the United States; and

8. The potential impact of the proposed transaction on the industry involved, including antitrust and competitive implications and the need for capital or technology for new services.

It should also be noted that there are generally no statutory limitations on foreign investments if they take the form of loans and debt securities. Traditionally, the FCC has not recognized even warrants or convertible debentures as equity securities until the conversion rights are exercised.

Another approach that may be utilized to permit increased levels of foreign investment is to review the nature of the firm's business activities. If what is critical to the continuation of its activities is not necessarily control of the radio licensed facilities, but merely the opportunity to obtain the radio-based services they afford, it may be possible to spin off the licenses to a separate firm that has no alien ownership in an arms-length transaction.(13) Under certain carefully designed conditions, the newly-formed licensee firm would provide services (such as transmission capacity) to the now license-free foreign-owned firm. For example, if foreign investors wish to acquire a facilities-based microwave interexchange carrier, they could instead operate the business as a reseller of capacity of a new firm established on a *bona fide* arms-length basis that is the assignee of the microwave licenses.(14)

Another alternative to consider is whether the firm could essentially carry on its business activities as a private, rather than a common, carrier.(15) In many situations, the

distinctions between common carrier and private carrier activities have become blurred by the FCC's forbearance with respect to most federal regulation of nondominant domestic carriers. Yet there are virtually no limits on foreign holding of private radio licenses except those applicable to foreign governments.

3.4 PERMITTED INVESTMENTS IN PRIVATE RADIO LICENSEES

There are fewer restrictions on foreign ownership of private radio licensees, because they are subject only to the provisions of Section 310(a). This provision only precludes issuance of licenses to foreign governments and their representatives, although it applies to both domestic and international facilities. Private carriers that carry third party traffic may operate microwave, satellite, and transoceanic cable facilities. For example, the PTAT private transatlantic fiber optic cable, which offers capacity to both carriers and end-users, was initially structured as a private carrier.(16) PanAmSat has initiated private satellite service as a separate satellite system operator.(17) Various microwave service providers offer end users domestic private microwave services via facilities licensed in the domestic Private Operational Fixed Service ("POFS").(18) Where facilities are to be utilized for the exclusive use of the licensee, even 100% foreign ownership may be authorized, as indicated by the Reuters decision, involving foreign ownership and operation of an Intelsat Business Service earth station used to transmit news reports in furtherance of Reuters' business of providing news stories to customers.

It should be noted, however, that private and common carrier facilities are not necessarily completely interchangeable. For example, POFS facilities may be interconnected with the public switched telephone network ("PSTN") only for transmission of business-related communications.(19) With respect to separate satellite systems, at this time interconnection with the PSTN is prohibited, although PanAmSat has requested that the FCC lift the prohibition.(20)

4. DOMINANT CARRIER TREATMENT OF CERTAIN FOREIGN-OWNED TITLE II INTERNATIONAL COMMON CARRIERS

In addition to the statutory restrictions on the ownership of radio licensees, there are also certain regulatory requirements imposed by the FCC as a matter of policy that are applicable only to certain foreign-owned international common carriers, whether or not they hold radio licenses. Unlike most foreign telecommunications markets, the United States common carrier market is open to participation by foreign-owned carriers, whether they are facilities-based carriers or resellers.(21) With respect to their domestic services, foreign-owned interexchange carriers are treated no differently from their U.S.-owned competitors, and are largely free of federal regulation. Certain foreign-owned interexchange carriers that offer international services are, however, treated as dominant carriers with respect to their international services, and are thus subject to additional regulation for both their domestic and their international services.

The foreign ownership issue arises in the context of an application for authority under Section 214 of the Communications Act (a "Section 214 application") to provide international services on a facilities-based or resale basis, or to obtain a transfer of control of a company already holding a Section 214 international authorization. In order to promote reciprocal treatment of U.S. carriers abroad, in certain situations the Commission will condition the grant of the requested authority on dominant carrier classification of the carrier with respect to its international services.(22) In some situations, a carrier may be treated as dominant only with respect to its service to a particular country.(23)

With respect to the international services of foreign-owned U.S. carriers, whether facilities-based or pure resellers, the FCC will impose dominant carrier regulation if one of the following circumstances is involved:

> 1. The carrier's board of directors includes a foreign government, a foreign PTT, a "foreign telecommunications entity," or a representative of one of such foreign entities; or
>
> 2. A foreign government, a foreign PTT, a "foreign telecommunications entity," or a representative of one of such foreign entities, holds a direct or indirect capital stock interest (including non-voting and preferred as well as common voting stock) of 15% or more

While the Commission may waive the 15% benchmark in cases in which it finds interests to be passive, it may also impose dominant carrier classification even in the case of debt relationships and equity relationships of less than 15% if they are not passive.

The most difficult problem, however, is interpreting the scope of the regulations, because the FCC has never explicitly defined what activities would cause firms to be characterized as "other foreign telecommunications entities." The FCC's intent is apparently to reach all foreign entities that may be in a position to exercise influence with foreign governments with respect to their telecommunications policies.

The FCC therefore extends the dominant carrier classification to telecommunications-related equipment manufacturers, suppliers, and service providers in an apparent effort to reach all entities with market power in their own

countries that could be used to exclude U.S.-owned firms from business abroad. The FCC clearly intended to reach such large non-U.S. telecommunications equipment manufacturers as Germany's Siemens or Sweden's Ericsson, in the event that either formed or acquired a U.S. interexchange carrier ("IXC") subsidiary with an international service Section 214 authorization. The definition of "foreign telecommunications entity" is so ambiguous, however, that in practice it seems to be applied to all foreign ownership interests, regardless of how tenuous or attenuated the connections of the parent to the foreign telecommunications industry or the potential clout of the parent firm at home.(24) Thus, it has apparently been applied to impose dominant carrier status on international IXCs affiliated with a wide variety of non-U.S. entities, including those involved in customer premises equipment, data processing, telecommunications consulting, as well as other lines of business more traditionally considered to be telecommunications activities.

The problem of dominant carrier regulation, however, is somewhat mitigated by the fact that the consequences of dominant carrier classification, while imposing administrative and other not inconsequential costs on carriers and some loss of flexibility in changing service offerings, are not so burdensome as totally to foreclose a carrier from competing effectively in the market. The additional requirements include:

1. Tariffs for international services must be filed on 30 days' notice.

2. Tariffs for international services must be accompanied by economic and cost support data.

3. Section 214 approval must be received from the FCC not only for initiation of service to a country (a requirement also applicable to non-dominant carriers) but also for modification of facilities or increases in circuits to a country.

4. Carriers must file their own and their parent or affiliated firms' operating agreements affecting traffic and revenue flows to or from the United States.

5. Carriers must file traffic and revenue reports with respect to their domestic services (although nondominant international carriers must file such reports only for their international services).

The issue of affiliation with a "foreign telecommunications entity" appears to have been raised most often when a competitor challenges a transfer of control of an international carrier and the proposed transferee is owned in part by foreign interests. In order to expedite the approval of the transfer of control application, the transferee may agree to accept dominant carrier classification on a temporary basis, subject to the filing of a request for termination of the classification and the FCC's approval of that request. Despite substantial documentation by several carriers of the lack of justification for the classification in their particular cases, however, to date the FCC has declined to act on any of the requests, which have in some cases been pending for years, and thus there has been no narrowing, or even clarification, of the definition of a "foreign telecommunications entity."(25)

Significantly, as a result of this inaction by the FCC, Cable & Wireless filed in December 1990 a petition requesting initiation of an FCC rulemaking proceeding seeking to have the FCC relax and identify with specificity the criteria for subjecting U.S. carriers with foreign ownership to dominant carrier regulation.(26) The petition argues that, at most, such regulation should be imposed only with respect to the carrier's "home" country, and only if the home country discriminates in some way against U.S.-owned carriers. One more lenient approach that has been suggested is for the FCC to limit its definition of "foreign telecommunications entity" by identifying those activities of a foreign affiliate that enable it to affect market entry by U.S. carriers, and not classifying a foreign affiliate as a "foreign telecommunications entity" if it does not engage in such activities. Another suggestion is that the FCC develop a process (such as adjudication of complaints by other carriers) for determining whether a foreign owner is in fact adversely affecting market entry by U.S. carriers in its home or other foreign countries, and issue authorizations subject to dominant carrier classification if the FCC finds the parent to have influenced market entry abroad.

Cable & Wireless' efforts in this proceeding parallel its efforts in other contexts, such as use of international private lines, that are apparently intended to force the FCC to address areas in which its requirements may be more stringent than those of other European administrations, such as the U.K., or where greater market entry rights for U.S. carriers abroad may be contingent on greater openness in the U.S. To date, however, the FCC has not yet initiated the requested rulemaking, and the dominant international carrier classification policy continues to be broadly applied.

5. SUBMARINE CABLE LANDING LICENSES

Like the use of dominant carrier regulation of foreign-owned international interexchange carriers, the submarine cable landing license law is now utilized chiefly to secure leverage to promote U.S. interests abroad. Initially, however, like the statutory restrictions on radio license holding, it was enacted after

World War I largely as a result of concern arising from German and U.K. dominance in the ownership of transatlantic cables.

Pursuant to the Submarine Cable Act of 1921, 47 U.S.C. § 34, the FCC, in coordination with the U.S. Department of State, is authorized to grant licenses for the landing of submarine telecommunications cables in the United States. While traditionally these cables have been owned by consortia of common carriers and capacity has been made available on a common carrier basis, in recent years several private fiber optic submarine cable systems have been established, including the PTAT-1 transatlantic cable and the North Pacific Cable ("NPC") transpacific cable.(27)

The statute specifically provides that licenses may be granted and withheld based on determinations as to the relative involvement of U.S. and foreign interests in the project and determinations of whether U.S. interests are receiving sufficiently reciprocal treatment by the foreign governments involved. While the FCC does not necessarily require that U.S. interests hold a half-interest in the project as a whole and be treated exactly in the same manner as their foreign partners, it will look to several factors to determine whether the benefits to the U.S. participants are sufficient. These factors include: 1) The proportion of U.S. to non-U.S. interests in the project; 2) the fairness of the contract procedures and opportunities for U.S. contractors to participate in the project; 3) the relative importance of the project to the public; and 4) the opportunities the project affords for U.S. investment abroad, including the degree of reciprocity shown U.S. interests abroad.

There are no specific standards to be applied in this analysis, so the determination may be quite fact-specific and may be affected by particular international policy concerns at the time the decision is made.

Ideally, from the FCC's perspective, the U.S. interests would own the entire U.S. "backhaul" network to connect the cable with carrier points of presence ("POPs"), would own one-half of the undersea cable system, and would receive one-half of the contracts awarded to construct the project. Recognizing that requiring complete equivalence is not always practical, however, the FCC will generally be satisfied if the first two conditions are met, U.S. interests receive reasonably reciprocal treatment abroad, and the contracting process ensures that U.S. firms have a real opportunity to obtain a reasonable proportion of the construction and maintenance contracts for the project.

Insofar as a project may represent one of the first opportunities for significant U.S. investment in a particular foreign telecommunications market, the FCC may also relax its policy with respect to the degree of reciprocity shown U.S. interests abroad. Thus, the FCC has interpreted the Submarine Cable Act in several instances to mitigate foreign ownership of several Pacific Rim cables. On the other hand, the FCC, because of looming international trade considerations and Congressional pressure, has been more vigorously scrutinizing and at least threatening to enforce more vigorously these provisions, at least as to certain trading partners.

6. CONCLUSION: TAKING ADVANTAGE OF CHANGING REGULATORY ATTITUDES TOWARD AND OPPORTUNITIES FOR FOREIGN INVESTMENT

There are numerous opportunities now for substantial foreign investment in U.S. telecommunications firms, and there are signs that the opportunity may exist for foreign firms to acquire even larger interests in U.S. firms in the future through possible Congressional relaxation of current statutory restrictions and FCC relaxation of certain regulatory policies. Foreign nationals cannot make U.S. telecommunications investments, however, without carefully considering the current U.S. restrictions on and policies affecting foreign investment in a particular industry segment. By careful planning, investors can structure proposed investments so as to avoid any preclusive restrictions, can facilitate timely grants of necessary approvals, and can minimize the degree of regulation to which a business may be subject.

Where U.S. policies are based on the availability of reciprocal treatment of U.S. interests abroad, careful review of national policies in the "home" country, and approaches to promoting reciprocal treatment of U.S. interests there, may also be helpful in bringing a contemplated U.S. investment to a successful consummation. Additionally, potential investors can work in the U.S. to promote the continued openness of various FCC and administration officials to recommending legislation that would give them the discretion to relax the statutory requirements, at least in response to a reciprocal opening of foreign markets to U.S. investors. Due in part to increasing pressure from U.S. carriers seeking access to increased levels of foreign investment capital, there is a growing sentiment that foreign investors from a nation whose telecommunications infrastructure is relatively open to competition from U.S. market entrants (e.g., United Kingdom) should be relieved from this statutory bar, particularly as U.S. carriers seeking entry in foreign markets are met with the response that concessions abroad may be dependent on an open entry policy at home. Thus, this is an opportune time for foreign investors to consider entry and increased investment in the U.S. telecommunications market.

ENDNOTES

1. There are, however, a substantial number of important types of investments in United States communications firms that do not implicate any foreign ownership restrictions. For example, there are at this time no restrictions on foreign ownership of U.S. cable television systems, movie studios, consulting services, information services providers, computer services, or equipment manufacturers. In the telecommunications area, there are no restrictions on ownership of domestic interexchange carriers or resellers, local exchange carriers ("LECs"), or competitive access service providers ("CAPs"), provided that they do not hold radio authorizations. Thus, in addition to common carrier firms such as Cable & Wireless, equipment manufacturers such as Siemens and Rockwell-Alcatel have active U.S. affiliates. (We note, however, that Public Law 100-418, 102 Stat. 1107 (1988), popularly known as the Exon-Florio Act, does allow the President to delay, prohibit, or require unwinding of any investment in any U.S. firm, in any industry, that is deemed to be a threat to U.S. security interests. To date, there has been formal action in only one situation, and that did not involve the communications industry.)

2. 47 U.S.C. § 301 et seq. (1988).

3. Private radio authorizations may be obtained for operation of such facilities as microwave and satellite systems, as well as for use by special types of users, such as motion picture companies, power companies, and emergency services. In a number of services, authorizations may allow facilities to be shared with other eligible users, even on a for-profit basis.

4. Radio Act of 1927, Ch. 169, 44 Stat. 1162, 47 U.S.C.A. 81 et seq. (repealed 1934).

5. See, e.g., Remarks of Chairman Alfred C. Sikes, "Globalization of the Telecommunications Market: Foreign Investment Issues," before the European Institute's Conference on "European Investment in the United States: Unity and Fragmentation in the American Market" (Sept. 23, 1991) ("Sikes' Sept. 23 Speech") at 4-5; Remarks of Janice Obuchowski, "Media Globalization From Prophecy to Fact of Life," (Sept. 13, 1991) at 7; see also, Continental Cellular, FCC 91-355 (released Nov. 20, 1991) at 3 (citing 68 Cong. Rec. 3037 (1927)). The communications industry is not unique in having such statutory ownership restrictions. See 16 U.S.C. § 797(e) (barring dam construction license grants by the Federal Power Commission to aliens and alien-controlled entities); 33 U.S.C. §§ 1502(5), 1503(g) (limiting ownership and operation of deep water ports to U.S. citizens and corporations); 42 U.S.C. §§ 2133, 2134 (barring the issuance of nuclear power plant licenses by the Nuclear Regulatory Commission to aliens, alien-controlled corporations, and foreign governments); 30 U.S.C. § 1015 (geothermal production leases on federal lands authorized only for U.S. citizens, corporations, and governmental entities); 10 U.S.C. § 2272 (restricting awards of aeronatical design contracts to corporations with less than 25% alien ownership).

6. Remarks of Alfred C. Sikes before the Columbia University Business School's Institute for Tele-Information, Special Evening Symposium on International Regulatory Agenda for the 1990s (Nov. 4, 1991).

7. See Sikes' Sept. 23 Speech; FCC News, Mimeo No. 14896 (Sept. 23, 1991).

8. "Obuchowski Calls Ownership Restrictions Solution in Search of a Problem," Comm. Daily, vol. II, No. 179 (Sept. 16, 1991) at 1.

9. "No Must-Carry Deal; Markey's Program Access Provisions Draw Cable Opposition," Comm. Daily, Vol. 10, No. 123 (June 26, 1990) at 1.

10. See Orion Satellite Corporation, FCC 90-241, File No. CSS-83-002-P-(M).

11. See Wilner & Scheiner, 103 FCC 2d 511 (1985), reconsidered in part, 1 FCC Rcd. 12 (1986) (holding that the alien ownership prohibition "applies equally to all financial interests in all business forms of licensees"); Reexamination of of the Commission's Rules and Policies Regarding the Atrribution of Ownership Interests in Broadcast, Cable Television and Newspaper Entities, 97 FCC 2d 997, 1009 (1984), reconsidered in part, 58 Rad. Reg. (P&F) 2d 604 (1985), further reconsidered, 1 FCC Rcd. 802 (1986) (collectively, "Attribution Orders"). In Wilner & Scheiner, the Commission stated that it would look to the standards for insulation of limited partners from attribution of ownership in determining whether a limited partner that was not a U.S. citizen was sufficiently insulated from participation in partnership activities to warrant ignoring the interest for purposes of the alien ownership restrictions. Recently, in Continental Cellular, FCC 91-355 (released Nov. 20, 1991) ("Cellular Foreign Ownership Decision"), the Commission relied on the Wilner and Scheiner decisions and upheld its staff's dismissal of 21 applications for cellular radio authorizations. (In 20 cases, at least one of the general partners was not a United States citizen, and, in one case, a limited partner who was not a U.S. citizen was found to be insufficiently insulated from partnership activities.) The FCC also held that the alien ownership defect could not be cured with a minor amendment, citing 47 C.F.R. § 22.918(b), although this defect may be cured during an "amendment-as-of-right" period with respect to radio broadcast applications. The Cellular Foreign Ownership Decision included a succint summary of the insulation standards of the Attribution Orders:

> The Attribution Orders required that in order for a limited partner's interest not to be attributed the partnership agreement must state, in express terms, that the exempt limited partner is prohibited from becoming actively involved in the

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> management or operation of the communications business of the partnership. Moreover, the exempt limited partner must not be allowed to vote for the removal of a general partner except for cause. Additionally, the limited partnership agreement must bar the exempted limited partner from serving, in any material capacity, as an independent contractor or agent. Finally, the exempt limited partner cannot act as an employee of the limited partnership if his or her functions, directly or indirectly, relate to the communications enterprises of the company.

Id. at n.22. The FCC also noted that a limited partner cannot use a private contract, rather than the terms of the partnership agreement, to insulate itself from management and thus secure an exemption from attribution. Id. at 7 n.23. The alien ownership restrictions have also been applied in cases involving other unicorporated interests, including mutual insurance company policyholders, Farragut Television Corp., 4 Rad. Reg. (P&F) 2d 350 (1965); members of a church, Kansas City Broadcasting Co., 5 Rad. Reg. (P&F) 1057 (1952); beneficial owners of irrevocable trust interests, Prime Media Broadcasting, Inc., FCC 88-218 (Jul. 12, 1988); and members of a labor union, Chicagoland TV Co., 4 Rad. Reg. (P&F) 2d 747 (1965).

12. See IDB Communications Group, Inc., 6 FCC Rcd. 4652 (1991).

13. The Commission is likely to scrutinize the transaction to ensure that the spin-off is in fact an arms' length transaction, and that the foreign owners do not gain de facto or other control of the new firm. See, e.g., Satellite Transmission and Reception Specialist Co., DA 90-927 (C.C. Bur. Jul. 13, 1990) ("STARS") (transaction initially disapproved as not being arms' length, but subsequent spin-off found to be acceptable and application for Secftion 214 authorization by the now-foreign owned firm approved). See also Licensee Limited Partnership 5 FCC Rcd. 1673 (1990); Com Systems, Inc., 5 FCC Rcd. 696 (1990).

14. To the extent that domestic microwave facilities are involved, and the new reseller does not offer international services, it would be regulated in the same manner as any other domestically-owned reseller. The Commission has adopted a policy of regulatory forbearance in most areas with respect to domestic resellers. See Competitive Carrier Services Docket (CC Docket No. 79-252), initiated by Notice of inquiry and Proposed Rulemaking, 77 FCC 2d 308 (1979); concluded by Sixth Report and Order, 99 FCC 2d 1020 (1985), rev'd sub nom. MCI Telecommunications Corp. v. FCC, 765 F.2d 1186 (D.C. Cir. 1985).

15. Private radio licenses may be issued to non-governmental foreign entities. Thus, Reuters obtained a private satellite system authorization to feed news reports to its earth stations at customer locations. Reuters Information Services, Inc., DA 89-899, File No. CSG-89-088-A (C.C. Bur. Aug. 3, 1989).

16. See Cable Landing Licenses, File Nos. I-S-C-L-84-002 and I-S-C-L-84-003, Mimeo No. 4618, released May 17, 1985; see also Tel-Optik, Limited, 100 FCC 2d 1033 (1985) ("Tel-Optik").

17. Establishment of Satellite Systems Providing International Communications, 101 FCC 2d 1046 (1985), on recon., 61 Rad. Reg. (P&F) 2d 649, on further recon., 1 FCC Rcd. 439 (1986).

18. See 47 C.F.R. § 94.1 et seq. Pursuant to the FCC's rules, POFS licensees may make their facilities available on a shared, and for-profit, basis to users that would themselves be eligible to be licensees of POFS facilities. 47 C.F.R. § 94.17.

19. See 47 C.F.R. § 94.13, 94.9.

20. See Petition for Rulemaking To Provide Fully Competitive Services, Including Services Interconnected with the PSTN, filed Jul. 18, 1990.

21. Carriers holding radio authorizations are subject to Title III foreign ownership limitations.

22. The implementing regulations are codified at 47 C.F.R. § 43.81. This policy was developed in the context of the Commission's proceedings concerning deregulation of international interexchange carriers. See International Competitive Carrier Policies, 102 FCC 2d 812 (1985), reconsideration denied, 60 Rad. Reg. (P&F) 2d 1435 (1986); Report and Order and Supplemental Notice of Inquiry, CC Docket No. 86-494, 64 Rad. Reg. (P&F) 2d 976 (1988) ("International Policies"), modified in part on reconsideration, 4 FCC Rcd. 323 (1989). Only nine carriers may be classified as dominant under this regulation because the FCC implemented the policy over the objections of the Office of Management and Budget ("OMB").

23. FTCC is classified as dominant with respect to its services to France because of its affiliation with the French Post, Telephone and Telegraph Administration ("PTT").

24. This policy, an attempt by the FCC to influence regulatory policies in foreign markets, is cited by foreign governments, particularly that of the U.K., in characterizing the United States telecommunications market as not truly open to foreign investment.

25. World Communications, Inc., 4 FCC Rcd. 2219 (C.C. Bur., 1989).

26. See Cable and Wireless Communications, Inc., Petition for Rulemaking (RM-7578, Dec. 3, 1990) (Public Notice Dec. 12, 1990, Report 1832).

27. See Tel-Optik; see also Pacific Telecom Cable, Inc., 4 FCC Rcd. 8061 (1989). Upon receipt of Section 214 approval from the FCC, common carriers may acquire and utilize capacity on private cables.

Telecommunications Regulation and Public Choice

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ABSTRACT

Conventional theories of telecommunications regulation overlook two critical determinants of policy choice: (i) the self-interest of government decision-makers; and (ii) the countervailing effects of technology and market forces. Public Choice theory accounts for these factors, thus providing a positive basis for understanding and predicting the evolution of regulatory policy in the United States and abroad.

1.0 INTRODUCTION

Changes in telecommunications policy have come to be regarded as the triumph of economic reason over regulatory incoherence. This paper challenges the conventional wisdom by arguing that policy choice is merely an artifact of the tension between the self-interest of government decision-makers on one hand, and the inexorable tendency of market systems to move toward the efficient utilization of technology. This conclusion has important implications for policy "planners."

The first section below examines some of the more commonly held theories of regulation, and introduces the broader perspective of Public Choice theory. he next section analyzes some aspects of telecommunications policy in the United States through the lens of Public Choice theory, and the following section similarly analyzes some aspects of regulatory policy abroad. The paper is summarized in the final section.

2.0 THEORIES OF REGULATION

Several theories have been proposed over the years to explain the nature and function of regulation. Unfortunately, none of these theories, whether taken alone or in combination, adequately explains or predicts the course of telecommunications policy in the United States and abroad. These theories fail partly because they are normative and descriptive rather than positive and predictive, and partly because they do not account for the self-interest of government decision-makers and the influence of technological change and market forces. Public Choice theory provides a positive basis for understanding changes in telecommunications policy and for predicting its future direction.

2.1 CONVENTIONAL THEORIES OF REGULATION

Conventional theories of regulation can be divided into two groups for discussion purposes: (i) the "public interest" theory; and (ii) "political" theories.

2.1.1 THE PUBLIC INTEREST THEORY OF REGULATION

The public interest theory presumes that government decision-makers are benevolent and omniscient, and that legislative and administrative rules represent honest and narrowly-focused attempts to maximize social welfare. Regulation is intended to prevent the pricing, output, and distribution problems caused by natural monopoly and other market imperfections by substituting behavioral rules (e.g., earnings constraints and common carrier responsibilities) for market forces. Adherents to this theory sometimes admit that regulation does not always protect the public interest as effectively as intended, but assert that results would be more desirable if only regulations were more numerous and invasive and enforcement efforts were increased.

This view of regulation plays well in public forums, but has come to be regarded as naive by economists who focus upon: (i) the substantial direct costs and economic deadweight losses attributable to regulation [1]; (ii) the gossamer public benefits of many regulatory policies; and (iii) the fact that regulatory tools are a demonstrably poor substitute for market forces when it comes to constraining costs and prices, and to achieving efficient levels of service quality and innovation.

2.1.2 POLITICAL THEORIES OF REGULATION

Political theories of regulation acknowledge that regulatory practices represent more than the blind benevolence and wisdom of public officials. The theories cited most often are these:

- The status quo theory: The purpose of regulation is to moderate the ebb and flow of wealth redistribution between consumers and producers. The apparent failure of regulation to react swiftly and efficiently to changing market conditions actually is an example of regulation performing its intended function. A variation of this theory posits that the purpose of regulation is to buffer and balance the avarice of public utility firms against the confiscatory tendencies of majoritarian democracy.

- The mediation theory: Producers and consumers desire an independent third-party to mediate and arbitrate ongoing transactions. Regulatory agencies fill this role by providing the forum and ground rules for discussion.

- The social contract theory: Regulatory authorities act as consumers' agents by negotiating and administering long term contracts with suppliers. Some regulatory reform proposals in the United States have adopted the "social contract" label although they have no direct tie to either the "social contract" theory of regulation or the "contractarian" theory of libertarian political thought.

- The taxation theory: Regulation is an extension of the "tax and spend" function of government, and is used to redistribute public and private wealth in ways that would not be countenanced if attempted through legislation.

- The economic theory: Regulation initially is introduced in a public interest vein, but subsequently becomes a captive of special interest groups, especially groups comprising the industries being regulated. Interest groups "demand" (and bid competitively for) regulations that foster strategic objectives. Government "supplies" (sells) regulation in exchange for political capital, private sector jobs, and other rewards. Policy choice favors the highest bidder, and regulation is transformed into a lawful form of cartel management.

Each of these theories describes some observable aspects of telecommunications regulation, but no theory adequately explains -- or could have predicted -- the policy changes that have occurred in the United States over the last two decades. On the one hand, regulation has perpetuated the status quo by delaying both the introduction of new technology and services, and the entry of new suppliers. Similarly, the continued existence of regulation in the absence of natural monopoly conditions and serious market imperfections suggests a fundamental demand for regulatory services by suppliers and consumers. And the fluidity with which individuals rotate their employment among regulatory, legislative, legal, and industry venues, coupled with the use of regulatory "taxation" to build political capital by redistributing private wealth, provides some support for the pessimistic predictions of the "economic" theory.

On the other hand, none of these theories adequately explains some critical aspects of regulatory policy. Contrary to the predictions of the "economic" theory, for example, resourceful and politically powerful telephone companies were placed at a competitive disadvantage vis-a-vis small, entrepreneurial rivals. Moreover, the burdens of cross-subsidization inexplicably were concentrated among a relatively small number of high-volume toll users, while the benefits were spread across a politically unorganized body of residential exchange subscribers. The "taxation" theory is contradicted by the fact that deregulated services have been those that were taxed most heavily under regulation (e.g., toll services). And none of these theories predicts that a regulatory agency would adopt reforms that lessen the scope of its own responsibility and authority.

The shortcomings and contradictions of conventional theories reveal them to be merely normative and descriptive explanations of the regulatory process. As such, they are not particularly useful for predicting the course of policy change.

2.2 PUBLIC CHOICE THEORY

A more fruitful approach to understanding the foundations of policy selection is Public Choice theory, an analytical approach that uses constructs of economics to explain government (i.e., non-market) decision-making. Public Choice theory is similar in many respects to the "economic" theory of regulation, although its perspectives are both broader and more dynamic.

A fundamental premise of Public Choice theory is that government decision-makers (i.e., lawmakers, regulators, and courts) have private interests that are furthered through the policy choice process. These interests lead decision-makers to maximize non-market objective functions that include such variables as: (i) the likelihood of re-election or re-appointment; (ii) campaign contributions and other side payments; (iii) future employment opportunities; (iv) budget maximization; (v) personal self-esteem, power and prestige; and (vi) the satisfaction that comes from shaping society according to personal preferences. Accordingly, Pubic Choice theory views politicians and bureaucrats as entrepreneurs, and political parties as business organizations that produce economic rewards for their creators and patrons.

The self-interest of decision-makers is served in part by using the power of the state to redistribute public and private wealth (property rights) among competing interest groups. As proposed by the "economic" theory of regulation, decision-makers supply redistributive rules and regulations through a market-like process in response to the demands of constituents and other groups. Wealth redistributions are effected in many ways, including those described by the traditional theories of regulation; e.g., taxation, status-quo maintenance, etc. Where political self-interest dominates the public choice process, policies are consistent with the public interest only to the extent that public and private interests are coextensive.

In return for providing (or merely for promising and/or threatening to provide) redistributive rules, decision-makers receive votes and other private benefits (e.g., campaign contributions, self-esteem, etc.). These benefits are termed "rents."[2] The systematic pursuit of rents is termed "rent-seeking."

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Rent-seeking is a predatory, non-productive, and socially wasteful activity. It is, however, a natural consequence of democratic social organization. Conferring legislative and regulatory authority on the state necessarily entails vesting decision-making authority in selected individuals. Once this authority is vested, it becomes a property right that decision-makers, as rational utility maximizers, have an incentive to exercise in ways that increase personal utility. In other words, there is an incentive for decision-makers to make choices that maximize the value inherent in the right to decide.

Public Choice scholars have shown that rent-seeking incentives can lead to policies that are both random and incoherent. A decision-making majority can (in theory) adopt virtually any conceivable policy given plausible sets of assumptions and circumstances. This understanding has led scholars (and an increasing number of judges) to dismiss the importance of "intent" when interpreting statutes and regulatory rules, not only because these rules are likely to be self-serving and mindless, but also because of the ease with which the underlying documentation can be deliberately distorted.

Despite strong empirical and anecdotal evidence, Public Choice theory frequently is criticized for its cynical premises and pessimistic predictions. A valid criticism of Public Choice theory is that it cannot predict a priori that all decision-makers always behave in a blatantly self-serving fashion, and that all policy choices necessarily are mindless and incoherent. However, the assumption that decision-makers, like all individuals, place positive value on self-interest provides a useful starting point for analyzing and predicting the course of policy choice.

Two relevant sets of forces check the ability of telecommunications regulators to pursue their self-interest. The first set comprises constitutional and statutory rules that prohibit confiscation of private property by the state. However, in countries like the United States where courts do not strictly enforce private property rights (except in the most egregious cases) where government "taking" is involved, parchment rules intended to check the expression of political self-interest via regulation can be of little practical consequence. Similarly, in countries where productive assets are owned and controlled directly by the state, checks against rent-seeking can have relatively little bite and, moreover, can be altogether absent.

The second set of forces checking political self-interest is technology-driven market forces. There is a tendency for organizational systems, both natural and man-made (political), to make efficient use of technology, even in the face of entrenched resistance. Competition for scarce resources provides an incentive for profit- and utility-maximizing individuals to employ the most efficient technology and methods available. In economies where competition for resources (and political power) is channeled through markets, technological change inexorably affects the private utility function of decision-makers by constantly creating new rent-seeking opportunities and eroding old ones. Policy choice tracks this ebb and flow.

This dynamic has shaped telecommunications policy in the United States, and is producing similar results abroad.

3.0 POLICY CHANGE IN THE UNITED STATES

Pressures to liberalize telecommunications policy in the United States grew out of microwave transmission technology and microprocessor-based switching systems. These technologies not only reduced the cost of telecommunications services, but also increased the quality and diversity of services that could be supplied. This, in turn, created pressure for decision-makers to conform regulatory policies to the state of technology. Pressure increased as the range of potential benefits grew to include the body of business and residential users.

Pressure for regulatory change initially was resisted by the Federal Communications Commission (FCC), state legislators and regulators, Congress, and the telecommunications industry establishment. One obvious reason for resistance was the breadth and depth of subsidies that had arisen as the result of falling unit costs. To decision-makers, these subsidies represented a stock of political capital and a source of decision-making rents. To the industry establishment they represented a source of wealth and x-inefficiency rents. These subsidies were not sustainable in the face of competitive supply and unrestricted user choice, and so resistance to policy change was inevitable.

Policy change was effected at the federal regulatory level well before any changes occurred at the state or federal legislative level. This suggests that the objective functions of the FCC and the federal courts were appreciably different from those of other cognizant decision-making bodies. Significantly, Congress has not enacted any meaningful telecommunications policy legislation (outside of broadcasting and cable) despite several opportunities to do so. Enacting legislation, as opposed to merely promising and/or threatening to do so, apparently does not maximize Congressional utility. Resolving issues through legislation would reduce long-term opportunities for generating decision-making rents by, for example, reducing the incentive of interest groups to deliver further electoral support (i.e., campaign contributions, votes, etc.). Reforming public policies too quickly (or at all) can fail to maximize the present value of decision-making rents.

Regulatory reform in the interstate toll services market illustrates both the process and the incoherence of U.S. telecommunications policy.

Limited competition (i.e., allowing large users to build private microwave facilities) was introduced in 1959 in response to pressure brought by large corporations. This policy subsequently was

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broadened to encompass private carriers (like MCI) that sought to provide common carrier services. Nevertheless, full and free competition continued to be viewed as a second-best alternative to comprehensive regulation.

In the 1960s, Congress persuaded the FCC to begin regulating AT&T's interstate operations and pricing more closely, ostensibly for the purpose of reducing prices. To this end, the FCC saw limited competition in long-haul services to be a useful regulatory tool. Economist William Melody (then a consultant to the FCC) presented the idea this way:

> The Commission could encourage the entry of new common carriers into submarkets the new carriers could supply efficiently... By following such a policy, the Commission would be using the market force of competition as a regulatory tool in the prevention of monopolistic price discrimination.[3]

Competition also was seen to be a means for checking AT&T's political power. As reported by author Steve Coll:

> ... MCI was unleashed, nurtured, protected, and defended by the FCC and Justice because, in the words of [former FCC Common Carrier Bureau chief] Hinchman's predecessor Bernie Strassburg, "AT&T was getting so big, so fast." Competition was a means for the government lawyers and bureaucrats to wrest power away from AT&T, to regain control over the phone company. Judge Greene, a former government lawyer himself, indicated clearly ... that it was AT&T's size and power that troubled him above all.[4]

Economists and policy consultants have tended to mis-interpret these policy changes in hindsight by viewing the introduction of competition as an intentional and benevolent movement toward economic efficiency and social welfare maximization. Economist Roger Noll, for example, has commented that:

> Astonishingly enough, economics played a central role in changing federal telecommunications policy, as acknowledged by Philip Verveer, the lawyer who developed the antitrust case against AT&T, the Chief of the FCC's Cable Television Bureau when cable was deregulated, and the Chief of the Common Carrier Bureau when the FCC formally adopted the policy of minimizing federal regulation of telecommunications. The intellectual foundation of these policies is an economic case that the industry will be more efficient if it is minimally regulated and maximally competitive.[5]

Although these policy choices clearly were consistent with economic theory, it was political considerations rather than social efficiency goals were the driving force. It is not surprising, therefore, to see that the remedies proposed by the government in its antitrust action against AT&T were viewed by many economists as being inconsistent with sound public policy. For example, economist Lester Thurow argued that:

> Technological advances will from time to time require changes in the rules of industrial competition. With the development of microwaves and satellites, the long distance transmission of messages may have changed from a natural monopoly to a potentially competitive industry. If so, rules and regulation governing the telephone business should be changed to reflect this development. Whatever should be done, however, the correct answer is not an antitrust suit against AT&T. A regulated monopoly should be governed by regulatory procedures and not by antitrust procedures. If the goal is a competitive industry in long distance transmission, an antitrust case is simply not the means for getting to this objective. Deregulation is best achieved by deregulation, not by a lengthy court case based on principles that have noting to do with regulation and deregulation.[6]

A Justice Department consultant similarly questioned the remedies being pursued by the government:

> Taking an action (such as divestiture) is certainly not free. It imposes substantial legal costs on both sides and substantial managerial burdens for implementation. Insofar as industries are moving in the "right" direction, it may be more economical to allow them to do so than to impose significant changes through government actions.[7]

In the end, however, policy choices governing industry and regulatory structure were made according to the preferences of the Justice Department's antitrust chief and the presiding judge. Author Steve Coll summarized the outcome this way:

> Certainly it is true that the government lawyers and bureaucrats at Justice and the FCC were not driven to break up the phone company by any clear, coherent vision about how a decentralized telecommunications system would work better than the existing one. The Justice lawyers, for example, never seriously believed that the operating companies would ever be divested, and until it became a necessity as the case was about to go to trial, they spent very little time drawing up plans for how the nation's phone network would be managed if they won their case. Instead, the government lawyers were driven by the conviction that AT&T was "unregulatable," as Walter Hinchman, the [FCC's] former Common Carrier chief, always put it.[8]

As the government's case against AT&T was being resolved, another federal judge sitting just a few doors down the hall was hearing a virtually identical antitrust action that had been filed against AT&T by (now) Sprint, a long distance competitor. To the surprise of many, this judge decided all issues in AT&T's favor and dismissed Sprint's claim. It seems fair to conclude that many important telecommunications policy issues

were determined more by the luck of the judicial draw than by abstract notions of economics.

The incoherence of U.S. telecommunications regulation has continued under the Modification of Final Judgement (MFJ) decree that settled the government's antitrust case against AT&T. Under the terms of the MFJ, the Regional Bell Operating Companies (RBOC) were prohibited (among other things) from providing information services and from manufacturing telecommunications equipment. These two restrictions subsequently became the subject of intense debate.
After protracted litigation, the "information services" restriction was abandoned. So determined was the MFJ court to keep this restriction in place (even in the absence of a supporting evidentiary record) that the Federal Court of Appeals eventually reprimanded the lower court for abusing its discretion in the matter.

The "manufacturing" restriction continues in effect. Legislation was offered in the Senate in 1991 that would allow RBOC entry into this line of business subject to a "domestic content" requirement. This requirement is both irrelevant and contrary to rational telecommunications policy. It is, however, perfectly consistent with the private interests of trade unions, domestic competitors, and trade-bashers. Although this legislation was not enacted, the episode tends to confirm another conclusion of Public Choice theory: public policies not only can be co-opted over time by interest groups (as predicted by the "economic" theory of regulation), but also can be hijacked at their inception.[9]

4.0 INTERNATIONAL TELECOMMUNICATIONS POLICY

Despite its incoherence, the evolution of telecommunications policy in the United States has demonstrated that reduced regulatory oversight, deregulation, and competitive supply can combine to yield positive economic benefits. These results might be expected to provide guidance and encouragement to foreign administrations that are pursuing privatization and regulatory reform programs of their own. The theory of this paper suggests that reforms abroad will occur more swiftly and with less incoherence than in the United States where policy reform has taken more than twenty years. On the other hand, beneficial reforms will not be adopted either automatically or immediately.

The prediction that reform will occur more quickly abroad than it did in the United States is based upon the fact that technology and competition are in a more advanced state today than they were when reform began in the United States. These forces are judged to be sufficiently strong to overcome two other factors that might facilitate political rent-seeking: (i) foreign jurisdictions have centralized, ministerial control over telecommunications and, hence, need not contend with the overlapping authority of numerous legislative, administrative, and judicial bodies; and (ii) foreign jurisdictions are not hindered by the existence of multiple firms functioning as quasi-independent PTTs.

Although market pressures are strong and growing stronger, reform is unlikely to occur as rapidly as might at first be expected. Witness, for example, the continued reluctance of decision-makers to reform even the most egregious policy distortions: (i) a $10 billion disparity between revenues and costs for international telephone traffic; (ii) monopolization and cartelization of international satellite services; and (iii) restrictions against the resale and sharing of domestic and international leased lines.

Foreign administrations obviously desire to protect the financial integrity of their telecommunications operations, and international service tends to be the single most profitable area of operations. High prices on originating international traffic, plus high accounting (settlement) rates for terminating traffic, generate substantial funds with which to subsidize domestic telephone services and a variety of other government services and programs; e.g., postal services and domestic computer industries. The funds available for these purposes have grown appreciably over time, essentially for three reasons: (i) facilities costs have fallen with the advance of technology; (ii) prices have remained rigidly high because of regulation and cartelization; and (iii) competitive supply and private network usage have been restricted.

Moreover, international settlement practices generate hard currency flows from the pockets of foreign nationals, especially those in the United States where the volume of originating international traffic greatly exceeds terminating volume. In addition, the asymmetry between the competitive U.S. market structure and the monopoly PTT structure allows foreign administrations to capture a portion of U.S. productivity gains by "whipsawing" competing carriers, especially through return traffic arrangements.[10]

The nature, breadth, and depth of domestic subsidies make existing policies resistant to change. Only a foolish or naive political administration would voluntarily replace such hidden taxes with explicit charges to be paid by its own citizens. The reduction or elimination of these subsidies not only would serve to dissipate accrued political capital, but also would reduce rent-seeking opportunities by reducing the amounts available for redistribution among competing interest groups.

Regulatory policies can be expected to change in step with changes in the private utility functions of decision-makers. As discussed below, pressure for change is coming from three directions: (i) changing macroeconomic perspectives; (ii) technological and market forces; and, especially in Western Europe, (iii) political re-structuring.

4.1 MACROECONOMIC PERSPECTIVES

The collapse of Eastern European economies under centralized economic management has shown that state ownership and administration of productive

resources neither creates operating efficiencies nor improves upon market processes as a means for distributing and allocating resources. This development augurs well for regulatory change, and undoubtedly has contributed to privatization and regulatory reform programs in several countries.

On the other hand, these programs so far have created only limited competition, especially for switched voice services. Privatized firms typically have retained monopoly service franchises that in some cases are written into the state constitution. Thus, privatization does not necessarily signify a fundamentally more liberal telecommunications policy.

Governments not only recognize that private ownership of telecommunications resources produces a larger economic product, but also recognize that this larger product can be redistributed for political gain via regulation. Accordingly, privatization and regulatory reform programs might represent nothing more than a plan to: (i) raise funds by selling off public assets; and (ii) use regulation to effect (or perpetuate) rent-seeking policy choices. The political fiddles needed to effect a plan of this sort are readily accommodated through the judicious use of such tenuous assertions as these: (i) the state must continue to formulate and coordinate industry policy; (ii) the state must prevent privatization and competition from destroying the existing telecommunications infrastructure; (iii) only the state can represent the country's telecommunications interests in the world economy; and (iv) scale and specialization economies exceed the benefits of unlimited competition and user choice in any event.[11]

4.2 MARKET FORCES

Fortunately for telecommunications users and suppliers, market forces will erode the opportunity for decision-makers to generate rents through restrictive regulatory policies. As communications-intensive information and service industries contribute an increasing share of a country's national economic product, aggregate telecommunications expenditures will increase. As this occurs, the ability of domestic products and services to be competitive in a world economy will depend critically upon rational regulatory policies. Technological developments will generate further pressure by making restrictive policies increasingly difficult to administer, and by creating new opportunities for users to end-run regulatory constraints; e.g., by routing traffic through countries that have more rational policies.

4.3 POLITICAL RE-STRUCTURING

Economic union in Western Europe will not affect domestic telecommunications policies directly. However, its spill-over effects clearly will put pressure on domestic regulatory policies as national boundaries and markets become subject to wider and more intense competition.

One important consequence of economic union is that firms can locate in countries offering the most favorable regulatory climate. This promise of foreign direct investment carries with it an implicit demand for services that are comparable to those available in other (e.g., home) countries. Conversely, firms that locate (or remain) in countries with less advantageous regulatory policies will find it easy and profitable to circumvent restrictive regulation; e.g., by routing traffic through telecommunications-friendly countries.

Spill-over effects also will serve to erode domestic telecommunications monopolies and, with that, the capacity of domestic markets to support rent-seeking. The beneficial effects of this erosion initially will be greatest for large-scale business users that have both political clout and the ability to substitute between alternative technologies (e.g., to substitute leased lines for direct-dial service). Residential users will realize fewer (if any) direct benefits in the short term for at least three reasons: (i) these users will remain captives of the local service monopoly; (ii) monopoly structure facilitates rent-seeking; and (iii) competition in other sectors of the industry will reduce the funds available for subsidizing local exchange operations, thus creating upward pressure on exchange rates. In the longer term, however, market forces will tend to displace policy distortions, and an efficient array of services and prices will emerge.

5.0 SUMMARY AND CONCLUSIONS

Regulation -- whether by administrative agency, legislation, or judicial decree -- represents the power of the state to redistribute public and private wealth among competing interests. It is always in the self-interest of decision-makers to wield this power in ways that increase their personal utility, whether utility is measured in pecuniary terms (re-election or re-appointment, future employment opportunities, side payments, etc.), or in terms of the private satisfaction and self-esteem that come from shaping policies and events according to personal preferences. This self-interest tends to produce mindless and incoherent public policies that serve the public interest only by coincidence. Policy reform proposals that fail to take into account the self-interest of decision-makers are short sighted and stand little chance of being adopted.

The incentive for decision-makers to seek rents, coupled with the limited information about market demand characteristic and economic costs that is available to regulators, make the "public interest" theory of regulation a fiction. Other conventional theories of regulation are best viewed as being normative and descriptive explanations of the regulatory process rather than positive and predictive theories of policy choice.

Despite its incoherence, policy reforms in the United States have been beneficial on the whole and, consequently, might be expected to serve as a beacon of encouragement to other countries. However, the same pressures and incentives that

have shaped policy change in the United States also operate elsewhere in the world. It is wrong, therefore, to conclude a priori that socially beneficial reforms will be adopted immediately and in full by foreign administrations. Rather, policy change will occur over time as an artifact of the tension between political rent-seeking incentives and the unrelenting pressure of technology and market forces. The advanced state of telecommunications technology and competition extant in the world today, suggests on balance that regulatory reform will occur more quickly and with less incoherence abroad than it did in the United States.

NOTES

1. In 1987, the National Telecommunications and Information Agency (NTIA) estimated the annual direct cost of telephone regulation in the U.S. to be $8 to $10 per local exchange line, about $2 of which was attributable to federal regulation. NTIA also estimated the indirect, "deadweight" economic losses from the interstate toll-to-local subsidy to be about $1.6 billion annually. Wharton Econometrics estimated in 1986 that the indirect cost of the interstate toll-to-local subsidy was about $50 billion in foregone GNP growth and 77,000 to 111,000 new jobs foregone between 1984 and 1991, in addition to adverse consequences for state and federal tax revenues and the U.S. trade balance.

2. More generally, a "rent" is a windfall gain that accrues to the owners of resources that are especially scarce. An example is the price premiums that are collected by monopoly suppliers.

3. Quoted in von Auw (1983), p. 124.

4. Coll (1986), p. 373.

5. Noll (1985), p. 52.

6. Thurow (1980), p. 145.

7. Brock (1981), pp. 300-301.

8. Coll (1986), p. 373.

9. See, e.g., Anderson and Tollison (1991).

10. See, e.g., Johnson (1991).

11. See, e.g., The Economist (October 5, 1991).

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Regulatory Issues in the Communication Policy of Hong Kong: Setting New Rules of Game for Broadcasting & Telecommunication

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1. ABSTRACT

With the worldwide trend of deregulation, emergence and convergence of new communication technologies and the run-up to 1997 when China resumes Hong Kong's sovereignty, the policy-makers in Hong Kong face a new communication environment with new players. The conventional wisdom of "positive non-interventionism" needs to be replaced by "forward planning" in communication policy to meet the new challenges posed by the new environment.

2. INTRODUCTION

Despite the fact that Hong Kong government does intervene in some sectors of the society, such as providing low-cost housing for the poor, packing the Hong Kong dollar with the U.S. after the nearly disastrous fall of it in 1983 due to political turmoil and the takeover of several private commercial banks on the brink of bankruptcy in 1983-84, the Hong Kong government to a very large extent holds an attitude of non-intervention in public policy. Government ownership of goods and services in Hong Kong is limited to law and order, postal services, the supply of water, and airport services. All other major public services such as electricity, gas, transport, telephone, telegraph and television are in private hands. There is no foreign trade restriction, no foreign exchange control and no central banking system. "Positive non-interventionism" is the term used by the government to describe its public policy.

A journalist attributes this non-interventionism to the inability of the government in helping the people after the Second World War. The government then could provide only rice and sympathy.[1] No matter what reasons are really behind the non-interventionist attitude, the government has relied heavily on private initiatives in providing communication services to the colony.

Hong Kong's first telegraph was set up in 1863 by Jardine, Matheson & Co and the first international telegraph to China was introduced by the Great Northern Telegraph Company in 1870. In 1877, the wonder of telephone was demonstrated by an interested civil servant, but he failed to impress the governor. Hong Kong had to wait for four more years to have the a telephone system. It was not until 1925 had Hong Kong a widely available telephone service. Marconi suggested twice to set up an Imperial Wireless Link including Hong Kong, one in 1910 and one in 1919, but Hong Kong did not have the service until 1925 because of repeated objection from the Admiralty in Britain.[2]

The reliance on private initiatives is also observed in the area of broadcasting. The formal inauguration in June 1928 of the first radio ZBW, which today called Radio TV Hong Kong (RTHK), was a result of the expatriates' enthusiastic quest for radio broadcasting.[3] The non-interventionist approach to communication was carried into the post-war era until 1990 when the policy makers were awakened to the need of the time to have more forward planning.

3. COMMUNICATION POLICY AFTER THE SECOND WORLD WAR

3.1 CHARACTERISTICS OF POST-WAR COMMUNICATION POLICY-MAKING

In the period after the Second World War, Hong Kong's communication policy exhibited four basic characteristics. They are "Act after problems arise", "Look for reference from abroad", "Wait for suggestions from private sectors" and "Trust the work to ad-hoc working parties". All these characteristics are typical of a non-interventionist government.

3.2 ACT AFTER PROBLEMS ARISE

This characteristic can be seen in many cases. In 1964, for example, due to increased population

and continued economic growth, the demand for telephone exceeded the telephone company's capacity to serve. It had a wait list of 34,000 applications and resulted in a black market for it.[4] One reason for such a lag behind the demand was bureaucratic red tape in granting new sites for more telephone exchanges.[5]

A more important reason was that the company's return on capital had declined from 14.3% in 1956 to 6.9% in 1963. Although the company's profit increased by 130% during the period 1956-1963, the capital which had to be invested increased by almost 300%. In other words, the incentive for the company to increase its services became negative. It is only after seven years when the public outcry against the poor service of the telephone company had reached an unprecedented pitch, the government proposed to amend the Telephone Ordinance to let the company to levy charges adequate to provide a return which could attract sufficient long-term private capital into the enterprise.[6]

In the area of broadcasting, an example showing the style of "Acting Afterwards" is the introduction of commercial broadcasting in 1956. Commercial radio was introduced not because the Administration wanted to instil more competition, nor did it have any great design for the role of commercial broadcasting. Commercialization of broadcasting was suggested because the government station, RHK, faced financial problems. The licence fees collected were insufficient to finance its growth. The original intent of the government was to introduce commercials in the programmes of Radio Hong Kong only. It hoped to bridge the gap between expenditure and revenue on the government station.[7]

But an amendment was made by M.W. Lo during the Legislative debate to introduce a separate commercial radio instead of commercializing some programmes of the government station. This amendment was agreed unanimously.[8] It was a very significant deviation from the original idea. A separate commercial radio would mean competition in wireless broadcasting and the maintenance of the tradition of public broadcasting. This outcome was quite interesting as it indicated that the plan formulated by the Executive was far from mature on the one hand, the legislature could have significant input in changing the policy on the other.

3.3 LOOK FOR REFERENCE FROM ABROAD

To look for reference from abroad was another feature of policy making in Hong Kong. In the United Kingdom, since the Conservative Party took power in 1979, privatization and deregulation have been the trend. After 1981, Britain introduced a series of measures to encourage competition in telecommunication. The Mercury was allowed to compete with the British Telecom in all sorts of network services. Customer premises equipment (CPE) and value-added network services (VANS) were open for competition. Cellular telephone was introduced 1985; four licences for cordless telephone (CT2) were issued in 1988 and three corporations were selected in 1989 to develop personal communications network (PCN).

All these developments in the U.K. were closely followed by Hong Kong. There are currently three mobile radio operators, four CT2 licencees (in Hong Kong it is called telepoint) and 17 paging licencees in Hong Kong. It is estimated that in 1991 the number of cellular telephones had reached 140,000.[9] At present, only telephone and international data services are still being monopolized because of the exclusive franchises for both will expire in 1995 and 2006. Both franchises are held by the Hong Kong Telecommunication International which was formed after the successful takeover of the Hong Kong Telephone Company by the Cable & Wireless Hong Kong in 1988.

In the case of television, reference was drawn heavily from abroad. When the Television Bill was introduced in 1964, the Colonial Secretary made it clear that the bill owed to similar legislation in Australia. A major feature of the Bill was to prevent foreign control of TV service and to limit cross-media ownership. It stipulated that not less than 60% of the voting shares of the franchised company should be owned by British subjects ordinarily resident in Hong Kong, and that voting shares owned by any non-British person or organization be restricted to 15% or less of the total. In addition, no competitor, supplier of broadcasting material or advertising agent may have a controlling interest in such company.[10]

Yet the underlying principles and means for carrying out these provisions in the context of Hong Kong were not worked out satisfactorily. In the second reading of the Bill several months later in 1964, the clause for restricting foreign control was struck out because "there might be such a risk if unduly onerous restrictions on shareholding

and share transfers made investment in the undertaking unattractive. ..... the public would not receive the standard of television which the Bill seeks to provide".[11]

In 1965, the Television Bill was amended again to make provision for the Governor to allow existing TV service provider i.e. Rediffusion wired TV service to get the franchise of wireless TV. It is interesting to note that in the amended bill, the provision against cross-media ownership was not struck out; instead, it was made to be "effective" only after the grant of the licence for wireless TV. This amendment was claimed to give the Governor "complete freedom to select the best and most suitable applicant".[12]

From the above, we can see that the policy making process in Hong Kong is always on an imitative basis with piecemeal amendments to suit the real situation. Despite the concern of cross-media ownership in the TV Bill 1964, up the present, Hong Kong still has no comprehensive legislation against cross-media ownership. With the emergence of more new media services, growth of capitalism and convergence of communication technologies, cross-media ownership will become a thorny issue in the years to come.

3.4 WAIT FOR SUGGESTIONS FROM PRIVATE SECTORS

Another characteristic of communication policy making in Hong Kong is to wait for private initiatives. The government only occasionally initiates new measures or services. In 1964 when the Telephone Company's service deteriorated to an intolerable level, it was the company itself to suggest for the improvement of service accompanied with an increase in charges. The general practice of the government is to act upon the suggestions, making adjustment and compromise. When the telephone company requested to raise the charges in 1963 to afford a return of 10% on capital employed, the Financial Secretary referred to the 8% of similar undertakings in the U.K. and the 7% of the American Telephone & Telegraphy Company in the U.S., and finally settled with 9% for the Hong Kong Telephone Company. The rate was claimed to be "related to conditions in Hong Kong".[13]

In 1957, the government indicated that wireless TV was not considered because of technical difficulties, but three years later in 1960, the government set up a working party to consider the development of television in view of the enthusiastic business interest in commercial wireless TV.[14] Such a "wait-for-proposal" practice prevailed up to 1990. When the satellite TV suddenly emerged in Hong Kong, it was the company making most of the suggestions as regards how it could be regulated in order to avoid the infringement of the cable franchise. In waiting for suggestions from private sectors, the government often loses its initiating influence, reacting passively to pressures exerted by business interests.

3.5 TRUST THE WORK TO THE AD-HOC WORKING PARTIES

In the past several decades, Hong Kong government did make some initiatives in the areas of telecommunication and broadcasting. Yet, most of the time, it relied on recommendations from ad-hoc working parties, which might or might not be composed of people with expertise in the issues concerned. In recent years, when confronted with highly technical issue, the government hired consultancy companies to do the job. For example, the Booz Allen & Hamilton was commissioned twice to examine the telecommunication situation in Hong Kong in 1987 and 1990.

The use of ad-hoc working groups is most obvious in the broadcasting field. It is almost an established practice of the government to appoint a working party to review the existing situation and provide recommendations as regards the renewal of the licence and related matters when a broadcasting licence is going to expire. For instance, when the 25-year licence of the Rediffusion's Wired Sound Service was due to expire in 1973, a working party was formed in 1970 to examine the future of broadcasting. When the licences for the wireless TV and commercial radio were going to expire in 1988 and 1989, a Broadcasting Review Board (BRB) was formed in 1984 to review the broadcasting situations and make recommendations on broadcasting policies. The advices of these two ad-hoc working groups have had tremendous influence on the development of broadcasting in Hong Kong.

The obvious disadvantage of relying on recommendations of ad-hoc working parties is the failure to keep track with changes in broadcasting, especially in a rapidly changing situation. For instance, the Working Party on the Future of Broadcasting 1971 recommended a tripartite system in commercial wireless TV i.e. to have

three competitors. In 1975, the third wireless TV, Commercial TV Ltd. (CTV) went into operation with heavy emphasis on instructional television which was conceived as a main reason for its existence by the Working Party. But three years later, it wound up because of heavy financial loss. After the demise of the CTV, an investigation was done with the conclusion that the market could not support three operators. Since then, no initiative has been made to re-examine the viability of a third commercial TV operator. In the BRB Report 1985, the idea was also passed lightly. It probably has to wait until the appointment of a next working party to have a chance for review.

The abolition of wired TV service in 1973 on the recommendation of the 1971 Working Party also left the pay-TV market untouched for more than 15 years. Until the idea of cable TV was proposed by the Broadcasting Review Board in 1985, nothing was seen as regards the possibility of tapping the pay-TV market. And the full idea of Pay-TV service was in fact picked up by the government only after the demise of the Cable project in 1990. Before it, the government had only an idea of "cable TV" which could rely on subscription and small amount of advertising. The possibility of tapping the pay-TV market by other means of technologies was not thought of before 1990.

3.6 INADEQUACY OF CONVENTIONAL STRATEGIES

In a way, these features in policy making are not necessarily bad since dealing with problems only when they are there would save misguided resources and waiting for proposals from private sectors would ensure that the services suggested are in demand and the business would be viable. To look for reference from abroad and consult specialist ad-hoc working parties is also desirable and better than working behind close door. The only problem is the delay in delivery or improvement of services. In a relatively isolated society with modest growth in demand for new services, such a policy orientation does not seem to be very unsatisfactory. After all, Hong Kong has become one of the most prosperous city equipped with modern telecommunication and broadcasting services since the Second World War.

But the question in the 90s is whether such a non-interventionist strategy can still render satisfactory communication service and keep Hong Kong abreast of the latest world development in communication, enabling her to keep her enviable economic and financial position in the world. From what had happened in cable TV and the second telecommunication network, it does not seem the non-interventionist strategy could continue to serve Hong Kong well. This is largely due to crucial changes in the communication environment since the 1980s. These changes of environment are due to three factors. They are first the worldwide deregulatory trend; second, the rapid development and convergence of communication technologies; and third, the imminent change of Hong Kong's sovereignty in 1997.

4. CHANGE OF TIME

4.1 WORLDWIDE DEREGULATORY TREND

The worldwide deregulatory trend was set by the U.S. In 1982, the AT&T's local telephone and telecommunication services were separated from the company. Its international services were also open for competition. In the area of broadcasting, almost all the regulations on cable TV were lifted in the early 1980s, leaving the regulatory work to local municipal authorities which conclude the franchise with the cable TV company. It resulted in tremendous growth for cable TV. In 1980, cable TV had a penetration rate of only 23% in the U.S., in 1990 the figure was 55%.[15]

Western European nations followed the step of the U.S. Britain went the farthest and deregulated nearly all its telecommunication and broadcasting services. The British Telecom and the Mercury are now competing in all aspects of telecom services, more than 20 exclusive regional cable TV licences were issued in the last ten years and a satellite TV service was introduced in 1989, which however had to merge with Murdoch's Sky Channel in 1990 due to financial difficulties. France and West Germany also deregulated their communication services in the 1980s. The laws of mid-1990 in Germany swept almost all restrictions in satellite communications and television. It has overtaken Britain which was the first European nation to introduce satellite liberalization.

What has happened in the advanced industrial world and particularly in the U.K. could not be passed lightly by Hong Kong which is a British colony well-integrated into the world capitalistic economy. The worldwide deregulatory trend subjects Hong Kong to pressure to liberalize its own services. Before the 1980s, demand from local or foreign interests to enter the traditionally monopolistic field of telecommunication and to offer new broadcasting services was small. In the

80s and 90s, the mood has changed to let new entrants join the game. "Over-protection" of conventional players is an unforgivable bureaucratic mistake in the 90s.

4.2 RAPID DEVELOPMENT & CONVERGENCE OF COMMUNICATION TECHNOLOGIES

In the 80s, communication technologies have developed at a quick pace and shown a tendency of convergence. Conventionally, broadcasting services are clearly separated from telecommunication as well as from print services. Radio and TV used to be regulated neatly by focusing mainly on their content, whereas telecommunication services were mainly regulated in respect of its technical standard. The message communicated over the telecom network or radio wave is largely a private matter of the users. Nevertheless, with the emergence of satellite TV, for example, such a distinction between broadcasting and telecommunication becomes blurred. Since satellite signals can become images and are widely receivable through Satellite Master Antenna, satellite communication can provide telecommunication as well as broadcasting services. The regulation is even more problematic if the uplink of the satellite signals is made in other countries.

In the case of video-cassettes, it is generally regulated as a print medium. It is not a "broadcasting" service although it is viewed on TV screen. But the pornography in video form, for example, has made video-cassettes distinctively different from the print medium. Similarly, computer porn and value-added services on telephone are no longer a purely telecommunication service although they utilize the telecom network. Hong Kong is facing these regulatory problems arising from the convergence of communication technologies and services.

Apart from regulatory problems, the rapid development and convergence of communication technologies also make the investment in new broadcasting or telecommunication services costly. For example, the defunct cable project of Hong Kong was estimated to involve an investment of HK$ 7 billion (U.S$ 0.9 billion). Even without laying a fibre optic network, just using the technologies of microwave to replace the horizontal trunk lines would still involve an investment of U.S.$ 0.38 billion.

Such a large scale investment in providing new services with new technologies makes the participation of big corporations necessary. The involvement of real big corporate giants in communication field is a new factor in the 90s. These big giants usually have had much influence in government or market, local or foreign. This setting puts the government in a difficult position when a big corporation tries to exclude the other to gain most of the advantages for itself. In the case of Hong Kong, the number of big corporations which can afford heavy investment in modern communications is small. The flex of muscle among the few big corporations in fighting for their best interest could drive the government into a corner.

4.3 CHANGE OF SOVEREIGNTY IN 1997

In 1997 Hong Kong's sovereignty will be reverted to China. Such a power shift has made the communication environment different from before in three respects. First, the uncertainty in future has made large investors hesitant in putting too much stake in Hong Kong. The political uncertainty has deprived Hong Kong of its opportunity of having more investors in large scale communication projects. This situation makes the few interested big corporations in Hong Kong more influential in the policy making process.

Second, the gradual fade-out of the British political influence in Hong Kong has reduced the authority of Hong Kong government, subjecting it to constant criticism from the corporations, the press and the general public. Before the 80s, the government decision was seldom challenged because of its capability in ignoring business pressure and public opinion. The colonial government since the late 80s has to take heed of criticism from private and public, otherwise its effective rule in the last few years may be jeopardized.

Third, the Chinese communists keep close watch on the development in Hong Kong before the transition of 1997. At the end of 1991, during a deadlock in negotiation between China and Hong Kong over the expenditure on the construction of a new airport, the Chinese government made it clear that all infrastructures and major affairs in Hong Kong crossing 1997 must have the opinions of China. This obviously includes telecommunication and broadcasting. In fact, the Chinese government protested against the granting of a 12-year franchise of Metropolitan Broadcasting to operate a second commercial

radio in 1991.

In telecommunication, the Chinese already exerted its control through its purchase of 20% shares of the only existing network of Hong Kong Telecom International in early 1989. After the demise in 1990 of the cable project which originally included a second telecommunication network and cable TV service, no decision regarding the tender for the second network is made up to this moment. The second Booz Allen & Hamilton study was finished a long time, problems in negotiating with China for a second network is probably one reason for the delay. The China factor affects the government policy process in two ways. One is to increase the political work in dealing with China. Second is to affect the participation and realignment of the big corporations, which will also need the goodwill of China, to conduct new services in broadcasting and telecommunication.

5. PROBLEMS ARISING FROM CHANGES OF TIME

5.1 DEREGULATION OF TELEPHONE & INTERNATIONAL DATA SERVICES

In 1988 when the government called tender for the second telecommunication network and cable TV service, it was stated clearly that the second network could provide all non-franchised services. As regards the franchised telephone and international data services, many bidders said they got the "impression" that competition would be allowed in a short time. But after the bid, the government did not make any clear commitment for the liberalization of telephone and international data services despite that fact that it was widely known that the first Booz Allen & Hamilton Report in 1988 recommended the end of the monopoly.

While the franchise winner, Hong Kong Cable Communications (HKCC) was hesitant of proceeding with the project, AsiaSat I was launched in April 1990 opening an opportunity for satellite television. The Hutchison Whampoa Ltd. lost no time in proposing to the government in July to launch a regional satellite TV service. The HKCC objected to such a proposal vehemently claiming that the satellite service would cream-skim its cable TV profits. Meanwhile, internal conflicts among the shareholders of the cable company became serious. At last, the HKCC quitted the cable project.

Probably, only the few people involved in the decision of setting up the second network know what had really happened to the indecision about the end of telephone and international data monopoly in Hong Kong. Without the services of telephone and international data communication, the heavy investment in a second network can hardly be justified. This is even more so in the context of political uncertainty due to 1997.

5.2 COMPATIBILITY BETWEEN CABLE AND SATELLITE TV

By the time when cable TV was proposed in the BRB Report of 1985, satellite television was something seemingly very remote. Nothing was mentioned in the report about such a possibility. Finally, when it emerged in 1990, the policy makers were caught in a dilemma. On the one hand, it had awarded an exclusive franchise to the cable company to run a subscription service, on the other hand, it wanted to keep the satellite service which threatened to move its base to somewhere else, which would cause embarrassment to the government. The cable company however insisted that both services were incompatible in Hong Kong and the satellite service infringed its exclusive right in providing subscription service. Finally, the government was torn between the two big corporations and forced by circumstances to make a compromising solution. Satellite TV was to stay but without local subscription, local advertising and Cantonese programming at least in the first three years. Unfortunately, the cable company still quitted the project for reasons other than the introduction of satellite TV.

The demise of cable TV and the second telecommunication network indicate very well that a clear plan for non-franchised telecom and cable services vis-a-vis franchised telecom services and other TV services is needed. The demise of the cable project also indicates that the reliance on recommendations from ad-hoc working parties might lag behind in a rapidly changing communication scene; it was only five years from 1985 to 1990, but communication technologies had already changed greatly.

5.3 REGULATION OF SATELLITE TV

Ever since the introduction of satellite TV service, the company has never stopped pushing the government for lifting the ban on Cantonese programming and local subscription. Now that the cable company is gone, the only opposition in the

industry is raised by the dominant wireless TV company Television Broadcasts Ltd. (TVB). TVB launched a publicity campaign in November 1991, releasing its own paper on the future of TV industry in Hong Kong, aiming at applying pressure on the government. It claimed that if the ban on local language programming is lifted, the satellite service will become a de facto wireless TV undercutting its audience and advertising revenue. They press for an early review of their licence which will expire in 2000, demanding the change of royalty structure and other conditions.

On the other hand, the satellite service launches constant attack on the "unreasonable" restriction on a local company from programming in local language, although it was a suggestion they made to the government so as to avoid infringement of the exclusive franchise of the now defunct cable company. In view of the changes in the communication scene since the demise of the cable company, an overall review of the whole television broadcasting industry is urgently needed. Whether or not the government will be able to do this is questionable because such an exercise is usually done by an ad-hoc working party which will be appointed only occasionally. Even with the appointment of such a working party, it is still doubtful whether the recommendations will not be outdated by events in a short period of time.

Since 1989, policy branches have been formed to take care of policies relating to telecommunication and broadcasting. Whether these branches can carry out the jobs of the ad-hoc working parties on a regular basis remains to be seen, but the separation of these two areas into two different branches i.e. Economic Services Branch for telecom services and Culture & Recreation Branch for broadcasting, already created some difficulty in the consideration of options in providing subscription TV in Hong Kong.

The emergence of satellite TV also raises the issue of cross media ownership. In Hong Kong today there is nothing like the anti-trust law in the U.S.; nor is there regulation governing cross-media ownership except in television broadcasting. Since the satellite company is a subsidiary of Hutchison Whampoa which also have shares in the second commercial radio i.e. Metro Radio, and have subsidiaries operating cellular telephone, paging services and CT2, some people express concern about the possibility of anti-competitive behaviour by some giant corporations and the monopoly of opinions in media. Whether this issue will be considered in the future review is not known. It is better to take it up early than before it is too late.

5.4 POLITICAL ADVERTISING

In the run-up to the reversion of Hong Kong's sovereignty in 1997, a series of democratic reforms have been introduced by the colonial government in the 80s. In 1991, there was the first time direct election to 18 seats out of 60 in the Legislative Council. Accompanied with this political change is demand for political broadcasting. Under existing provisions, no political advertising is allowed on broadcast media, yet provision is also there for the governor in council to establish standards for the broadcasting of programmes containing political material.

In the 1985 BRB Report, nothing was mentioned about political programmes or advertising. No standards have ever been established regarding political programmes. During the election campaign in 1991, an issue arosef when the United Democrats of Hong Kong, the largest political democratic party, wanted to place a radio advertisement for a fund-raising concert. The issue was whether such an ad for fund-raising constituted political advertising which could be construed to mean only the promotion of the candidate or parties directly and explicitly. There was no explicit definition of the word "political". Finally, the ruling of the Broadcasting Authority was to define it broadly to include any messages that would directly or indirectly benefit the party or political candidate concerned. The United Democrats finally dropped the case although they intended to ask for a judicial review.

This incident again indicates insufficient forward planning. Some ways must be found to improve the policy process to anticipate and accommodate the changes of communication environment in Hong Kong.

6. SETTING NEW RULES OF GAME

6.1 FORMING PERMANENT POLICY-MAKING STRUCTURE

In view of the rapid changes in the communication environment, a permanent policy-making structure to monitor the continuous development and to plan ahead is urgently needed. This structure must comprise people with expert knowledge in the concerned areas. At present, the policy

branches dealing with telecommunication and broadcasting are headed by administrative officers with generalists' background, which is a tradition of the British civil service. Technical experts i.e. people of departmental grade who will not be transferred in and out of a department, are largely involved at the level of providing expert knowledge only, seldom are they directly involved in making the decision. Those who are responsible for making major decisions are usually administrative officers moving around different departments, handling a variety of related or unrelated subjects. Such an arrangement necessitates occasional appointment of working parties or hiring of consultancy service to study the broad issues of communication.

In order to meet the challenges of the time, the decision-making body of communication must be composed of people on a permanent basis with expert knowledge in economics, communication, engineering and law, in addition to people excelling in political bargaining and manoeuvre. They are not only responsible for making the decision, but monitoring the progress and making necessary adjustments. Most important of all, they should plan well ahead of the oncoming of new services and new communication technologies.

Forward planning by people with expertise on a long-term basis would also help to reduce the suspicion of China about the British intent in liberalizing the communication services in Hong Kong. Such a body can also deal more effectively with the industry which may mislead the policy-makers by manipulating technical information.

6.2 SETTING OUT PLANS TO ACCOMMODATE COMPETITORS

In the 90s, the new rule of game in telecommunication and broadcasting is to encourage competition. Development and experience in the past several decades indicate that the rationale for maintaining monopoly in communication services no longer stands. It has been found that communication monopolies in the advanced industrial countries are over-protected. The argument for maintaining economy of scale and scope in providing the best service does not seem to be sustainable in view of the fact that new entrants do make profits and the service rendered under competition is better than before. The idea that monopoly is necessary for the provision of universal service e.g. telephone, through cross-subsidization of unprofitable sector by profitable one may be valid in an underdeveloped economy. In the 90s, Hong Kong has developed into an advanced economy, the cross-subsidization argument cannot hold any more.

In the case of cable TV monopoly, the idea of cross-subsidizing some "desirable" services by lucrative services also proved to be impracticable since there were too many such money-losing services required on the operator. The role of public broadcasting is better served by a public broadcaster financed by public fund than by requiring commercial operators to play a full role of public broadcaster. Such a "full role" requirement would reduce the flexibility of the commercial operators, making them financially difficult even in the case of monopoly. The best rule seems to be one which lets the players decide how they are going to play in the market.

In retrospect, in the broadcasting history of Hong Kong, the two failure cases of television, i.e. Commercial TV Ltd. in 1978 and Hong Kong Cable Communications Ltd. in 1990 shared one common feature. It is the stringent requirement of them to play the role of a public broadcaster. In the case of CTV it was instructional TV; in the case of cable TV, it was the provision of a great variety of channels which served to look good in the tender, rather than to provide profitable entertainment services.

6.3 LAYING GROUND RULES FOR EQUAL FOOTING ONLY

This lesson brings us to another point in setting the new rules. Not only plans must be considered ahead in accommodating new competitors, government should limit itself to laying down ground rules for different players only. Always let the players fight out the result of the game is the best way in communication planning. Requiring the private sectors to do jobs which should be done by the government, e.g. public service broadcasting or cross-subsidizing the poor telecommunication users may result in failure or inefficiency of the services.

From past experience, a better way to set the new rules is simply to ensure free entry into the market. What the government should do is just to lay down ground rules for the competitors to stand on equal footing in the game. Then, let the players play. However, the government after preparing a level ground for all players should continue to monitor the game to ensure fair play on a long-term basis. In monitoring the game, some legislations in curbing anti-competitive

behaviours, which are absent now, are urgently needed. Without such legislations, the game can hardly be played successfully on a long-term basis.

7. CONCLUSION

In view of the changing communication environment, the government needs to improve its policy process by relying less on recommendations of ad-hoc working parties, taking more initiatives in making policy and planning ahead, anticipating and accommodating new players who are usually financial giants, refraining from granting monopolies in communication services, resisting the temptation of requiring private business to provide a substantial amount of public services which are the responsibility of the government, making new entry into the market and fair play a norm and after all, setting a permanent decision-making and monitoring body with relevant and adequate expertise.

NOTES

1. Robin Hutcheon. *SCMP: The First Eighty Years*. Hong Kong: South China Morning Post, 1983, p. 96.

2. The early development of telegraphy and telephone in Hong Kong in nicely re-captured in Austin Coates. *Quick Tidings of Hong Kong*. Hong Kong: Oxford University Press, 1990.

3. *RTHK - 50 Years: Broadcasting in Hong Kong from 1928 to 1978*. Hong Kong: Government Information Services, 1978.

4. *Hong Kong Hansard: Reports of the Meetings of the Legislative Council of Hong Kong - Session 1964*. Hong Kong: Government Printer, 1965, pp. 276-8.

5. This reason is suggested by Austin Coates. *Op. Cit.* p. 171-2.

6. *Hong Kong Hansard - Session 1964*. Hong Kong: Government Printer, 1965, pp. 267-75.

7. "Future of Broadcasting" (A sessional paper discussed in the Legislative Council of Hong Kong), *Far Eastern Economic Review*. March 1, 1956, pp. 280-4.

8. Controller of Broadcasting. *Annual Departmental Report For Financial Year 1955-56*. Hong Kong: Government Printer, 1956, pp. 1-3.

9. *Datapro Reports on International Telecommunications*. September, 1991, p. 206.

10. *Hong Kong Hansard - Session 1964*. Hong Kong: Government Printer, 1965, pp. 181-3.

11. *Ibid*. p. 372.

12. *Hong Kong Hansard - Session 1965*. Hong Kong: Government Printer, 1966, pp. 401-3.

13. *Hong Kong Hansard - Session 1964*. Hong Kong: Government Printer, 1965, pp. 268-73.

14. Hong Kong Government. *Hong Kong Annual Report 1957*. Hong Kong: Government Printer, 1958, p. 293; Broadcasting Review Board. *Report of Broadcasting Review Board*. Hong Kong: Government Printer, 1985, p. 185.

15. Joseph Dominick, Barry L. Sherman & Gary Copeland. *Broadcasting/Cable & Beyond: An introduction to Modern Electronic Media*. New York: McGraw Hill, 1990, p. 258.

1992 Pacific Telecommunications Conference
Honolulu, Hawaii

EFFECTIVE REGULATORY PROCEDURES: THE FOUNDATION OF SUCCESSFUL TELECOMMUNICATIONS REFORM

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1. ABSTRACT

Successful privatization and regulatory reform in the telecommunications sector depends in large part upon the implementation of effective regulatory structures with the attributes of consistency, transparency and flexibility. This paper examines some of the fundamental aspects of new regulatory structures, including allocations of jurisdiction among governmental authorities, selection of appropriate organizational form, development of substantive expertise, arrangements for funding, and establishment of administrative procedures that ensure public access to decision making.

2. INTRODUCTION

Privatization and liberalization in telecommunications markets the Pacific as well as in all other regions of the world, are creating an urgent need for reform of telecommunications regulatory processes. Regulatory structures and procedures are at the gateway of new telecommunications services. The regulatory process, how it is organized and how it functions, is a critical element in assessing the actual or potential impact of telecommunications on national growth and regional integration. A poorly-structured regulatory system can paralyze telecommunications growth by impeding the development of substantive policies and eroding public confidence in the decision-making process. On the other hand, a well structured regulatory system will significantly enhance telecommunications development by ensuring that developments in the private sector are consistent with public goals and that the governmental decision-making does not unnecessarily constrain the innovation and efficiencies of private enterprise. Thus, an effective and efficient reguatory process is critical to the achievement of economic, technical, social and political objectives.

Successful creation of a new regulatory structure requires careful consideration of a number of fundamental issues, including identification of specific goals for the regulatory process, a well thought out organizational form for a regulatory entity with clear allocations of power and responsibility and, establishment of decision-making procedures to ensure the fairness of the regulatory process.

Each country necessarily will devise its own unique regulatory structure based upon the options available under existing law and the objectives that are intended to be achieved. However, there are certain common threads and fundamental principles that may usefully guide this difficult process. This paper is addressed primarily to those cases in which governmental regulation of private enterprise is a new phenomenon. It focuses on the critical areas of structural, jurisdictional, and procedural issues which must come into play in establishing an entirely new regulatory system.

3. FUNCTION OF THE REGULATORY PROCESS

3.1 Determination of the Role and Function of the Regulatory Agency

The very first set of issues to be addressed in structuring a regulatory system is identifying the desired role and function of the regulatory agency. In markets where one or more basic services operators have dominant market power,, there is a critical role for the government to play in ensuring subscibers that the dominant operators will provide adequate service at reasonable charges. In mixed markets containing elements of both monopoly and

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competition, the need for a regulatory presence may be even more pronounced. The regulator identifies those segments of the market appropriate for competition and helps, through regulation of rates and rate structures as well as technical interconnection requirements, to establish market conditions that reduce barriers to entry.

In either case, a strong and effective regulatory presence is often a critical guide the the efficient introduction of competition, the consistent achievement of social goals as technology and services constantly change, and the oversight of relations with the national systems of other countries and multilateral organizations in international markets.

The role of the regulator in any particular market will be related, in large measure, to the existence and effectiveness of antimonopoly laws. In Venezuela, where there are no applicable antitrust laws, substantial attention was paid to the creation of an effective regulatory entity and system at the outset of the privatization process. In contrast, both New Zealand and Chile virtually eliminated regulatory functions at the time that their national telephone systems were privatized, placing substantial reliance on the then existing antitrust laws to ensure opportunities for competitive entry. However, in recognition of the fact that antitrust laws do not substitute for a forward-looking policy development process, Chile is now reexamining the issue of regulatory functions.

3.2 Organizational Objectives

The regulatory process becomes more complex and difficult as market relationships become more intricate. This is particularly true with the introduction of competition, which involves the licensing of multiple operators, allocations of scarce radio frequency spectrum for new services, and establishment of technical standards for interconnection of competitive networks. Nonetheless, it is critically important that decision-makers maintain the objective of ensuring that the regulatory process is efficient and avoids unnecessary impediments to the functioning of the marketplace. It should be an objective of the regulatory process to promote innovation and increasing reliance on market forces. Moreover, decision-makers should endeavor at every step and at every level to reduce to a minimum the varieties of approvals required for any market initiative, and to clarify and streamline regulatory procedures. In other words, it is crucial to reduce the incentives for "self aggrandizement" of the regulatory entity.

3.3 Substantive Goals

Any new regulatory system should have, at its foundation, the following three goals. The first goals is consistency. This is critical for public and investor confidence. The regulatory structure must be stable and should be guarded, to the extent possible, from arbitrary political change. While the regulatory process must be responsive, in a broad sense, to prevailing political mandates, the individuals entrusted with regulatory decision making must be relatively insulated from removal for purely political reasons. Additionally, the substantive decisions reached by the regulatory entity should be constrained, to some reasonable degree, by prior decisions. In other words, regulatory policies and the tools utilized to implement those policies must have some degree of consistency with the past.

The second goal is transparency. The regulatory process must be conducted openly and rationally. Insurance of transparency must involve some provisions for access by the public and regulated companies to information about the decision-making process. It also

requires the establishment of clear administrative procedures and penalties for failure to follow such procedures.

Finally, the regulatory process must have flexibility. While regulatory decision-makers cannot have unlimited discretion, they must be given wide latitude to adjust policies and requirements to changes in circumstances. Technology and services are changing constantly, as are customer requirements. The regulatory process must have built-in flexibility to adjust to these developments or it will become useless within a very short period of time.

4. STRUCTURAL ISSUES

4.1 Constitutional Context

Any effort to establish a new regulatory system within an existing government must begin with an evaluation of how the regulatory function fits within the existing constit ²θutional structure of the country. The first level of this inquiry is to assess the "horizontal" allocations of jurisdiction and authority at the central government level. These allocations will be different, depending upon the system of government and the laws existing in a particular country. For example, allocations of authority and options for a regulatory structure will vary substantially between an executive form of government under a common law system, such as the U.S., a parliamentary form of government under a common law system, such as the U.K. and an executive form of government with a civil law system, as prevails in much of Latin America and Europe. Even within the general framework of the combination of executive governmental systems, there are many variations of allocations of power and jurisdiction under individual country constitutions.

In addition to the "horizontal" allocation of responsibilities and powers at the central government level, the constitution will also establish "vertical" allocations between the central government and the regional or local governments. Under some constitutions, regional or local governments will not have any constitutional authority over public services such as telephone networks. Under others, local governments retain certain direct authority. Legal systems which require shared authority between the central and regional governments often result in complicated regulatory structures and difficult jurisdictional disputes. The dual state/federal regulatory system in the United States is a prime example of these potential complexities.

4.2 Organizational Form

Once a the decision has been made as to which branch of government has the constitutional power to establish a regulatory agency, the specific organizational form of the agency must be established. Sometimes, "organic" laws dictate specific organizational forms and restrict alternatives.

In addition to the fact that existing laws may constrain options for establishment of a new regulatory agency, in many countries, privatization and liberalization of telephone administrations require a multistep, transition. In countries that have never had privately-owned or operated telecommunications companies, the first step of the transition is to reorganize the state-operated PTT (Postal Telegraph and Telephone Administration). The operational functions of the PTT usually are placed in a new state-owned operating company, while the regulatory functions are removed to a ministry of communictions. Subsequently, a new regulatory agency may be established either inside or outside of the ministry. Also, the operational entity may be fully or partially privatized.

The selection of the appropriate organizational form for the new

regulatory entity requires a balancing of several different factors, including insulation from political change, responsiveness to social policy concerns, independence of judgment and reliability of sources of funding. If the regulatory function is to remain within the executive branch, one alternative may be the separation of communications from other infrastructure areas, such as the postal service or transportation, and the creation of a new ministry or department dedicated solely to communications. The advantage of this approach is that it provides very high level authority for issuance of communications policies. I also may permit the centralization of all communications issues (both telecommunications and mass media) in one administrative body. However, this approach has the disadvantage of adding a major new bureaucracy to the governmental structure. Also, as a ministry or department, it is not insulated from political change. Moreover, funding would normally be provided through the general treasury, with appropriations approved by the legislature. Thus, a purely executive branch structure is responsive to the policy directions and political directives of the administration in power, but may not have the necessary financial or political independence for the establishment of telecommunications policies on a consistent and stable basis.

As an alternative, a quasi-independent commission, agency or other authority may be established within or in connection with a ministry or department. Such a regulatory structure already has been established in a number of some Latin American countries, including Mexico and Venezuela. Under this approach, the telecommunications regulatory functions are separated out from other ministry activities. A separate head of the commission or agency is charged directly with responsibility for the regulatory function. This structure does minimize the tendency to create additional bureaucracy and does provide some independence of decision making, particularly if the head of the Commission or agency has a term of office that is independent from the term of office of the minister. However, this structure does not solve the problem of lack of insulation from political shifts, particularly if the minister has the authority to exercise full discretion to remove the head of the commission or agency. Also, under the subministry or departmental office approach, the issue of funding becomes critical. The subministry will have to secure a certain proportion of the general treasury allocations on a consistent basis. An additional advantage is that the subministry structure can normally be established by presidential decree, and does not require new legislation. Therefore, it can often be a good transition step to a more independent regulatory agency which may require establishment through a well thought out new statute.

Finally, there may be various forms of "independent" agencies which may be possible to implement in a particular country. Such a new entity may be modeled on either a new or existing form of government entity. Again, sometimes permissible governmental forms are constrained by specific provisions in the constitution or a governmental "organic" law. An independent entity most likely would be modeled on one of the following general types of forms: a controlling or enforcement entity, which may be part of either the legislative or executive branches of government, an independent commission which would function primarily as a policy setting organization, or an operating entity which would be a form of a state-owned enterprise authorized to impose fees and retain revenues. In all of these alternatives, the issues of selection and removal of leaders, and the insulation of such leaders from other political forces, become critical.

It is of paramount importance to ensure that the form of regulatory entity selected has the power and authority to carry out all of the varied responsibilities of the regulatory process. Regulatory activities include quasi-legislative functions of establishing regulations, quasi-executive functions of establishing overall policies as well as granting individual licenses, and quasi-judicial functions of resolving disputes and investigating malfeasance or failures of performance.

Moreover, it may not be necessary to settle on the form of an entity that has singular and exclusive responsibilities for telecommunications policy and administration. It may be that both the executive branch and the legislative branch will require some participation in the regulatory process. The executive branch inevitably will need to participate in the establishment of general policies and the president normally will want to maintain an administrative advisor on communications issues. Similarly, the legislature may also demand a regulatory agency responsive to its agenda and obligated to justify its expenditure of general treasury funds. It may be inevitable that the regulatory process that ultimately evolves includes at least a couple of different agencies or offices, all responsible for a slightly different aspect of the communications regulatory function. In common law systems, the judiciary will also play a key role in refining the justifiability of policies and the extent of legal authorities.

4.3 Special Issues of Power and Jurisdiction

In the telecommunications industry, there are several specific issues that require careful assignment of power and jurisdiction. Only two particular ones are mentioned here. The first is with respect to the radio frequency spectrum. Different portions of the spectrum will be used for public telecommunications services, private telecommunications services, mass media services and governmental operations. Ideally, the allocations for these uses should be closely coordinated. As technologies begin to merge and services become more integrated, it is particularly beneficial to have a single regulatory entity that has primary responsibility for all frequency allocations and license assignments for all non-governmental uses, including public and private telecommunications as well as mass media (broadcasting). The frequency allocations for government and non-government may be handled by different organizations, but should be closely coordinated. Some mechanism may need to be provided for resolution of disputes on frequency allocations between government and non-government interests. Such disputes often arise around national security issues. Ideally, the arbiter of any such disputes should not itself have any vested interest in frequency allocations (such as the military).

It is also important to establish clear responsibility for participation in international consortia and organizations. For example, the privately-owned public services provider may function as the signatory to Intelsat and Inmarsat. However, the regulatory entity should direct the participation of the signatory in the decision-making meetings of these international organizations. Moreover, the regulatory entity must direct the participation of delegations representing the government in the official meetings of the International Telecommunications Union. Other governmental agencies, including the foreign ministry, also may have a role in establishing national policies to be promoted in multilateral and bilateral international negotiations.

4.4 Composition of the Agency

After the basic form of the regulatory entity has been decided upon,

it will be necessary to consider the structure of the entity itself. As an initial matter, the size of the entity, (the commission, board, office, council, sub-ministry or whatever organizational form is selected), will be an important factor. An effective regulatory entity can be comprised of as few as one director with a small staff. In the United Kingdom, the Office of Telecommunications is organized in this way. Such a structure avoids unnecessary bureaucracy and may be highly efficient, particularly in markets characterized by monopoly or duopoly service providers with whom the regulatory authority can directly negotiate. However, as the telecommunications market becomes more diversified, involving both monopoly and competitive elements, regulatory issues, functions and procedures become more complex and decisions become more controversial. In such circumstances, a regulatory body with three or more members and a professional staff of economists, engineers and lawyers may ensure more balanced decision-making. The political structure of the subject country, including the number of political parties, as well as legal requirements (i.e., obligations to include a certain number of representatives of the labor unions on a decision-making board) may influence the number of members of the regulatory entity. Usually, however, a board of either three or five members is the most efficient. In the U.S., the FCC originally had seven members and now has five. Many experts believe that the larger structure was unwieldy and made decision-making difficult.

More crucial than size is the consideration of how the members of the regulatory entity will be appointed, approved and removed. Depending upon the legal form of the regulatory entity, members may be appointed by the president, the congress and/or the minister or secretary that heads the governmental department within which the agency is located. It is advisable to provide for selection process not only requirements for a mixture of political parties, but also to build into the selection process some checks and balances. For example, in the U.S., FCC commissioners are appointed by the President, but must be approved by the Senate. Additionally, the Chairman is selected by, and serves at the pleasure of, the President. If a new regulatory entity is part of a ministry, the members of the governing board may be appointed by the minister. This carries some risk that the commission or board may be too responsive to political shifts. However, this problem can be overcome by providing strict limitations on the circumstances under, and means by which, the members of the governing board can be removed.

The commissioners or board members should not be removable for any reasons other than adjudicated malfeasance, such as fraud or corruption. Any incentive and ability of the president, minister or the legislature to remove a commissioner or board member for political or policy reasons should be avoided. Instead, commissioners and board members should serve for prescribed terms. The terms may be staggered so as not to coincide with the presidential term or other political election cycle.

4.5 Legal Systems and Instruments

The nature of a legal system in a particular country will dictate the types of legal instruments that must be developed to establish the regulatory system. In a common law system, legal instruments at the highest level of authority are usually the most general, with increasing levels of detail provided by legal instruments in successively lower levels of the legal hierarchy. In civil law systems, greater specificity may be required at the higher levels of the legal hierarchy. In part this is due to relatively lesser reliance on judicial interpretation. Rather, unless the

highest level of legal mandate, e.g., a statute, provides an express grant of authority, the power to exercise such authority, e.g., through the issuance of an administrative regulation, or the negotiation of a concession agreement, may be deemed not to exist. Consequently, in civil law countries just now establishing telecommunications regulatory structures, it may be crucial to have regulatory goals and objectives, as well as the nature of particular regulatory tools that can be used, specified in some detail at the higher levels of the legal hierarchy. This may help to minimize disputes over regulatory powers. This may also reduce the flexibility that the regulatory entity has to address unforeseen circumstances, but it may be important, especially at the outset, to ensure the effectiveness of the regulatory process. In view of this, it may be useful to build into the process of the creation of a new regulatory system periodic review of the appropriateness of certain regulatory powers and tools.

In summary, the creation of a regulatory system requires a thorough understanding of the legal hierarchy in the subject country, and an appropriate matching of particular statements of regulatory goals, objectives, powers and tools with the appropriate legal instruments in that country. This can and should involve a detailed analysis of the objectives and policies, as well as procedures, that should be implemented from the outset for the reformed telecommunications sector. Ideally, such an analysis should be undertaken for each segment of the industry, (e.g., domestic basic voice services, international services, value added services, cellular and other mobile services, terminal equipment, etc.). The analysis would produce, not only an initial set of goals and policies, but also a strategic plan for the establishment of specific regulatory powers and authorities at each level of the legal hierarchy (including statutes, decrees, resolutions, regulations and concession agreements). In this way, the initial goals and objectives of sector reform in a partiular country, as well as the regulatory tools and powers necessary for such reform, can be comprehensively and appropriately identified.

4.6 Funding

The issue of funding is critical to the sustainability and effectiveness of a new regulatory system. Part or all of the funding for a new regulatory entity may come from congressional appropriations from the general treasury. Depending upon the structure of the regulatory entity, such appropriations may be allocated to the ministry within which the new regulatory entity is located, or to the commission, or agency itself if it is constituted independently from the ministry. Such general treasury allocations usually have to be justified annually, and may involve some substantive oversight by congressional committees of regulatory activities. Such general treasury allocations provide a good foundation for the regulatory budget. Other sources of funding may provide important supplements to the general treasury allocations.

An additional source of funds could be a percentage of the concession payment submitted by winning bidders in the privatization of the basic services telephone company or the grant of a valuable service franchise, such as a cellular telephone system. Such funds can provide a substantial resource in the early stages of regulatory reform. However, it is important to have some idea of the size of the regulatory budget early in the planning process, and it is difficult to plan a general budget based on uncertain receipts from a future auction. In any event, concession agreement payments, particularly from privatizations, may be very helpful for the initial establishment of a regulatory system, but a continuing source of annual income

should be separately identified.

A reliable and independent source of income that does not flow through the general treasury can enhance the independence of the regulatory process. Other sources of income for the regulatory system may be operator fees, taxes or surcharges and/or processing fees. Operator fees involve the assessment of particular amounts on different categories of service providers (e.g., the monopoly telephone company, cellular operators, satellite operators, private networks, etc.). Usually, the imposition of such fees would require legislative approval, and may require special authorization as a particular form of taxation. Additionally, arrangements must be made for the collection and accounting of such fees. Some countries may require that the fees be collected into the general treasury. If possible, if not collected directly by the regulatory entity, such fees should be "earmarked" for allocation to the regulatory entity budget.

Processing fees are not a tax, but rather are fees paid by applicants upon the submission of applications for facilities or system authorizations or for requests for regulatory approvals. A schedule of fees may be devised to cover a wide variety of regulatory activities. Again, arrangements have to be made to direct the receipts, or some substantial portion thereof, to the regulatory entity.

In structuring any schedule of fees, care must be taken to evaluate the tolerance in the market of such fees, and to avoid introducing any significant market distortions through the fees themselves. Fees should neither create nor alter market incentives. Additionally, fee structures and collection arrangements should be avoided that encourage the growth of the regulatory bureaucracy. Some control should always be maintained on the regulatory budget.

5. SPECIAL EXPERTS AND ADVISORY COMMITTEES

Any country establishing an entirely new regulatory system inevitably will experience a shortage of expertise in regulatory issues. Over time, this shortage can be ameliorated with special training programs. However, it is likely to take several years to assemble even a small staff with adequate training and background to address the myriad of complex legal, economic, technical and policy issues that will arise in the swiftly changing telecommunications industry. In addition to training programs for the long term development of expertise, several mechanisms may be considered for the short term to provide the new regulatory entity with expert advice.

First, every endeavor should be made to secure the highest possible pay scales for regulatory employees that are consistent with a particular country's civil service laws and requirements. This will help to attract to the new agency high level expertise already existing in industry, academia and private legal and economic consulting practices. Second, the regulatory entity may be empowered, perhaps under special legislation or residential decree, to hire outside experts on a contractual basis. Especially for the early years, access to the substantial expertise already developed in other countries would substantially facilitate in-house training. It also could be a critical element in the successful development of initial policies and procedures. Finally, a new regulatory entity may find substantial advantage in having access to either standing or ad hoc professional advisory committees.

Such committees may consist of representatives of the industry and/or other professional experts. Such an advisory committee would conduct factual analysis and made recommendations to the regulatory body, but would not have any

decision-making power. In the U.S., advisory committees are widely used by various government agencies, including the FCC, and are required to follow certain rules and procedures. Generally, ad hoc advisory committees, charged with developing a recommendation on a particular issue and constituted with the appropriate mix of accountants, engineers, lawyers and business representatives, may be most useful. A standing advisory committee may be able to provide only general advice on particular issues. Another potential disadvantage is that, depending upon the rights and powers granted to such a committee, a standing advisory committee may impose an additional level of bureaucracy on the regulatory process. This may impede efficient decision making.

6. PROCEDURAL ISSUES

6.1 The Need for Administrative Procedures

The establishment of sound and reliable administrative procedures is critical to the success of the regulatory effort. The purpose of such procedures should be to ensure the openness and fairness of the regulatory process. In some countries, administrative procedures are already established. However, even in cases where general principles of administrative procedure have already been developed, specific procedures for the operation of the regulatory entity must be identified. Such procedures will include, among other things, the manner of handling applications for services, negotiating concessions, adopting policies and issuing regulations, providing information to the public, responding to complaints and claims, handling challenges to regulatory decisions and providing members of the telecommunications industry with recourse against regulatory decisions with which they disagree.

6.2 Instruments of Regulatory Activity

New administrative procedures must be related to the specific tools that the regulatory agency will use in the conduct of its business. Normally, the regulatory authority will engage in some or all of the following activities: 1) adoption of general policies regarding classifications of services, technical requirements, allocations of frequencies to services and determinations of those portions of the market subject to competition, 2) assignment of licenses for radio facilities, negotiation of concession agreements, and review of tariffs and 3) resolution of disputes and investigations of complaints. Each set of regulatory activities will require specific procedures. Individual procedures for specific regulatory activities should be designed with reference to an overall framework. This overall framework should include a consistent approach to such issues as allowance for public participation in regulatory decision making and opportunities for challenge and/or judicial review of administrative decisions.

6.3 Public Access

One of the critical elements of an open and transparent decision making process is public access to information about the process. Public access takes many forms. First, the public should be apprised of the fact that certain applications have been filed with the regulatory entity. This permits members of the public as well as potential competitors an opportunity to evaluate or challenge proposals submitted to the regulatory entity for approval. The question of how much information about the proposal should be made public is a matter of protection of commercially proprietary information. Each country must find its own balance between satisfying the need for public access to information on th one hand, and protecting the interests of applicants

in secrecy and promoting efficiency, on the other. For example, in Australia under the proposed new rules for the new regulatory entity AUSTEL, formal procedures for public access have not been mandated, out of a concern for inefficiency, expense and delay. However, as a consequence, the openness of the regulatory process may be compromised.

The second form of important public access is notification of actions taken by the regulatory entity. Any decisions made by the regulator should be summarized, or published in full, in a volume which is easily accessible to the public. A requirement that agency decisions be committed to writing and published will enhance the credibility and consistency of the regulatory process.

An additional important feature of procedures for public access is control on lobbying activities. Specific procedures should restrict access by interested parties to decision making personnel on an "ex parte" basis. In other words, if other interested parties may be directly affected by the outcome of a particular decision, specific procedures should limit the ability of one interested party to gain access to decision making personnel without notifying or including the other interested parties. Certain other types of lobbying activities, including the giving of gifts of monetary or other substantial value, also me be restricted. Such restrictions would help to ensure the openness and fairness of the decision making process, as well as avoid incentives for corruption.

6.4 Enforcement Powers

In addition to decision making powers and procedures, the regulatory entity must have powers and procedures for the investigation of violations of regulatory requirements and the enforcement of such requirements through imposition of fines and other sanctions. Enforcement mechanisms may include, in addition to monetary fines, conditions placed upon a license or a consortium agreement, or ultimately the revocation of a concession or license. In addition to providing for the powers of the regulatory entity to enforce its decisions, enforcement procedures must also include avenues of recourse for regulated entities to permit orderly challenges to regulatory enforcement determinations.

7. CONCLUSION

The credibility and efficiency of the regulatory process will be one of the most crucial elements of any telecommunications reform. As described in this paper, the creation of a new regulatory structure is a complex and multifaceted undertaking. It also involves lengthy and complex efforts to identify the appropriate structures and procedures. Many times, there are severe time pressures under which telecommunications reforms may take place. Often, due to election timetables, there is a narrow "window of opportunity" for the enactment of telecommunications reform legislation. Sometimes such time pressures cannot be avoided, and statutes must be introduced, even if they are not optimum. In such circumstances, leaders of telecommunications reform must make their best efforts to come to reasonable compromises and put in place a functional regulatory mechanism. It may be just as well, then, to defer the passage of a new telecommunications law, if possible, and to implement a transitional approach by decree. In any case, it may be a good idea to provide for a review of the planned regulatory structure, after a certain time has passed and some experience with the market has been gained.

ENDNOTE

1. Copyright Aileen A. Pisciotta 1991. Mrs. Pisciotta is International Communications Counsel for Latham & Watkins. Mrs. Pisciotta has represented both governments and private companies in telecommunications and broadcasting matters, including privatization and regulatory reform projects in Japan, Australia, and New Zealand as well as in Latin America and Europe. Most recently, Mrs. Pisciotta advised the Venezuelan government on the creation of a new telecommunications regulatory system in connection with the privatization of that country's national telepone system, C.A.N.T.V.

DEVISING A WINNING STRATEGY FOR DEREGULATION

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The winds of deregulation are sweeping through the telecommunications services industry worldwide, to the benefit of most customers, but with significant, often negative, implications for the former monopolists. (Exhibit 1 lists the many countries that are planning to privatize telecom services.) McKinsey & Company's involvement in six of the most significant of these deregulation cases has allowed us to develop a deep understanding of the key challenges, strategy options, and shareholder value implications of major regulatory change. This paper takes the perspective of a dominant carrier's senior management and highlights the issues, sources of vulnerability, and strategic imperatives that must drive the response of a telecommunications company facing major deregulation.

NOBODY REALIZES JUST HOW MUCH IT WILL COST

Deregulation is often described as an event, but it is more appropriately viewed as a process that unfolds slowly, but with ever-increasing intensity. Consumer dissatisfaction with the price, quality, or availability of telecommunications services provided by the dominant carrier usually provides the initial impetus for change, although deregulation for purely political purposes or for the sake of following international trends is increasingly enough of a reason.

At the beginning of the process, government objectives are poorly understood, policy options only partially developed, and criteria for choosing among options ill-defined at best. Initial proposals are narrowly defined, focusing on privatization or the introduction of competition for a limited number of services. Dominant carriers often believe that such initiatives can be contained or that the value loss is not so great to justify a strong response. We would observe that, with the thin end of the wedge thus inserted, the opening of the door soon follows.

The cost of deregulation to the existing monopoly provider is usually grossly underestimated by the deregulating government and the provider itself. A telling measure of the shift in value is the cumulative return (stock appreciation plus dividends) to shareholders of the deregulated telecommunications company relative to other companies in the stock market. In the five years after deregulation in the United Kingdom, British Telecom's value compared to the market declined by 39%. This has been a relatively good result. In Japan, NTT's value has declined relative to the market by 70% since deregulation (Exhibit 2).

There are three major reasons for this decline in value:

- Competitors focus on the most attractive customers. This "cherry-picking" has a greater impact on the dominant provider's network economics than the expected share loss would suggest.
- Deregulation often tilts the playing field in favor of new competitors to give them a head start. Regulators rarely understand the extent of this tilt until it is too late and new entrants have made substantial, often unnecessary, investments.
- The monopoly provider often is ill-prepared for competition and loses significantly more share and profit than need be. Preparing for competition requires major cultural change as well as clear strategic positioning. Major cultural change takes years, leaving the company in a catch-up situation when it can least afford it.

WINNERS WILL DO FOUR THINGS WELL

We have suggested that deregulation is best viewed as a process with an increasing tempo. Importantly, it is also one with many stakeholders and therefore an array of often-conflicting objectives. The specifics of any deregulation situation will vary greatly, so no single recipe can cover

all situations. However, based on our work with dominant carriers, regulators, and potential entrants, we do see some common winning themes for organizations facing deregulation:

1. Manage deregulation proactively
2. Anticipate competitors' likely approach, and seek to gain a first-mover advantage
3. Shift as quickly as possible to a customer focus
4. Effect major cultural change in the organization.

Manage Deregulation Proactively

Our experience has shown that negotiating a well-structured regulatory framework is a more important driver of the dominant provider's financial performance in the five years after deregulation than achieving operating improvements or market growth. For instance, the difference in interconnect price arrangements alone can be worth approximately 30% of a major carrier's free cash flow.

As well as the obvious loss of value this causes, loss of free cash flow also limits capital competitiveness by reducing capital available for new network investment, new product investment, and capital-labor substitution at the same time the need for this is heightened.

The deregulation debate is particularly challenging to manage because the issues are extremely complex and in most cases interrelated (Exhibit 3). In our experience, this complexity often works against the telco. Lacking compelling proposals from the carrier, the regulator's solutions eventually are driven by political concerns and philosophical principals, and "the problem we are trying to fix" gets lost in the complexity of the issues.

Carriers facing deregulation must shape the debate on two levels. Discussions with the regulator must be detailed, purposeful, and pursued well before deregulation becomes a matter of public debate. Once public, the carrier's position must be positive and thematic. The most important issues that drive the shape of the competitive playing field, and therefore future financial performance, include the following:

- **Interconnect price arrangements.** Physical, commercial, and technical agreements with new competitors (e.g., equal access arrangements, network access charges, and equipment co-location requirements) will determine areas of competitive vulnerability.
- **Pricing flexibility.** Witness the enormous difference in outcomes between KDD and NTT because NTT is greatly constrained in its ability to compete on price (Exhibit 4).
- **Pricing mix.** Will access charges, which rarely cover costs and are subsidized by long distance and international, be restructured? The competitor will cherry-pick the latter and leave the dominant provider with the former.
- **Nature of the competition.** The key points here are the number of full network competitors and the arrangements for resellers.
- **Product market access.** Will the former monopoly be allowed to offer the full range of value-added or mobile services, or will it be precluded on the basis that competitors need an advantage to get started?
- **Profit regulation agreement.** Are returns capped or guaranteed? How will consumer prices be determined? Over what time frame is the agreement valid? Will the dominant provider have sufficient capital to compete in a tougher environment, especially when free cash flow is reduced by the impact of competition?

Successful deregulation management is not a zero-sum game. It is possible to "fix the problem" while wreaking minimum havoc on the dominant carrier's long-term competitiveness. To protect itself, the dominant carrier must stay one step ahead of the negotiations by rigorously assessing the economics and competitive implications of various options. Understanding what has happened in other international deregulation cases has proven extremely valuable in shaping an optimal outcome. These results of these inquiries must be coherently communicated to the government or regulator to help shape the deregulation debate, by introducing issues to be resolved and developing a common fact base for evaluating options.

Anticipate Competitor's Likely Approach

The dominant carrier must begin fighting in the new competitive arena even before its new competitor has been chosen. Analysis of a telco's business can pinpoint areas of weakness and predict a competitor's likely strategy. Very focused moves can then be made to minimize loss of share, customers, and

profit within the new regulatory framework.

For instance, the dominant carrier must understand:

- What routes and products are most susceptible
- What pricing flexibility is required to combat these threats
- What the impact of different interconnect terms will be on a competitor's ability to offer discounted services
- Which customers are most vulnerable and likely to switch to the competitor.

Internal "war games" - in which staff take on the roles of the former monopolist, competitors, regulators, and other interested parties - can significantly increase understanding of competitor strategies, the impact of different deregulation initiatives, and the viability of potential countermeasures. Fresh thinking on the strategies and economics of future entrants can also yield insight into ways to improve existing operations and deliver better value to customers who may be tempted to switch carriers.

Our experience suggests that a clear understanding of new entrants' likely programs and an effective first-mover response can reduce share loss by as much as 10-15%.

Develop a Customer Focus

The most critical shift the existing telco needs to make at the time of deregulation is to develop a clear customer focus. Without the pressure of competition, monopolies and regulators frequently adopt a "serve the average customer well" approach. This leaves some customers paying for service levels they do not value, while others feel underserved and frustrated at their inability to get better performance at any price.

It is customers who will decide whether to use the incumbent or the competitor. Much of the challenge in matching the competitor requires developing an understanding of customers to a degree never before necessary. Three major issues need analysis:

- What customer segments are there? What do customers in each segment really want, and what are they prepared to pay? Answering these questions is essential to develop the most effective product packages and pricing structures, and to create non-price sources of competitive advantage.
- Which customers are profitable and why? Which customers is the company prepared to lose, and how much will it cut price or increase service levels to retain profitable customers?
- How can the company increase switching costs so that existing profitable customers find it less attractive to shift to a competitor even on a trial basis?

Building the skills throughout the organization to carry out this level of analysis and the capability to deliver highly differentiated levels of customer support is critical to success. Programs must be developed before the competition arrives to attenuate customer complaints and allow time for experimentation and refinement.

Move the Internal Army

Jan Carlzon's comment on the importance of customer interactions in the airlines industry, "40,000 moments of truth," is equally applicable to today's competitive telecommunications environment. Every front-line customer interaction must be better than those of the competitors. For most customers, switching costs are low, and any interaction may prompt switching or retention. The internal army must be moved along a number of dimensions to achieve a new external, customer-focused, results-oriented perspective (Exhibit 5).

This type of deep-reaching organizational change is the hardest task of all for telco managers facing deregulation. Significant structural change is also involved, such as replacing functional departments with customer-specific business units. Cultural change on this scale can take six to eight years with a very committed and focused team. Most companies facing substantial deregulation, however, typically only have two to four years.

Our recent experience working with telcos over the past five years has led us to believe that major change can be achieved in this timeframe, and typically requires three distinct phases of activity:

- **Preparing for change:** This stage involves developing the commitment and a commonly shared vision in the top management team and tailoring a program to ensure change reaches pivotal front-line and middle-management positions.

- **Making change happen:** For customers to see real results, change must happen at all levels of the organization. Competitive pressures often necessitate that it happen everywhere, at once. This involves virtually everyone in the company and thousands of man-years of focused effort aimed at bridging the gap between current and future required levels of performance.

- **Ensuring the change becomes self-sustaining:** Systems, processes, and the internal mindset of all staff must be changed to encourage continuous improvement. Employees at all levels must learn to benchmark performance, diagnose the causes of performance gaps, and roll out new approaches to achieve continued improvement.

At one telco, a two-year program of this nature has led to significant results: customer dissatisfaction fell 85%, productivity improvements averaged 9% per annum, and profitability increased over 400%.

CONCLUSION

How an incumbent telco faces deregulation will determine its performance over the next 20 years. Virtually everything is at stake, and the challenges are enormous.

The telecommunications industry may well follow a path similar to that of the airline industry. Changes in the technology and resulting economics of international services will lead to bypass of domestic providers within the next 20 years, with only 10-12 major players dominating the global scene. Enormous international service opportunities may exist and can be very profitable if well managed, as illustrated by Cable and Wireless' performance. In the rush to provide domestic competition, governments can unwittingly give away a local telco's chance of long-term growth and even survival.

Telcos facing deregulation can benefit substantially from those who have gone before. These experiences suggest that winners will take aggressive steps to prepare for competition. They will:

- Proactively manage the deregulation process to achieve important objectives while compromising in areas of lower competitive impact

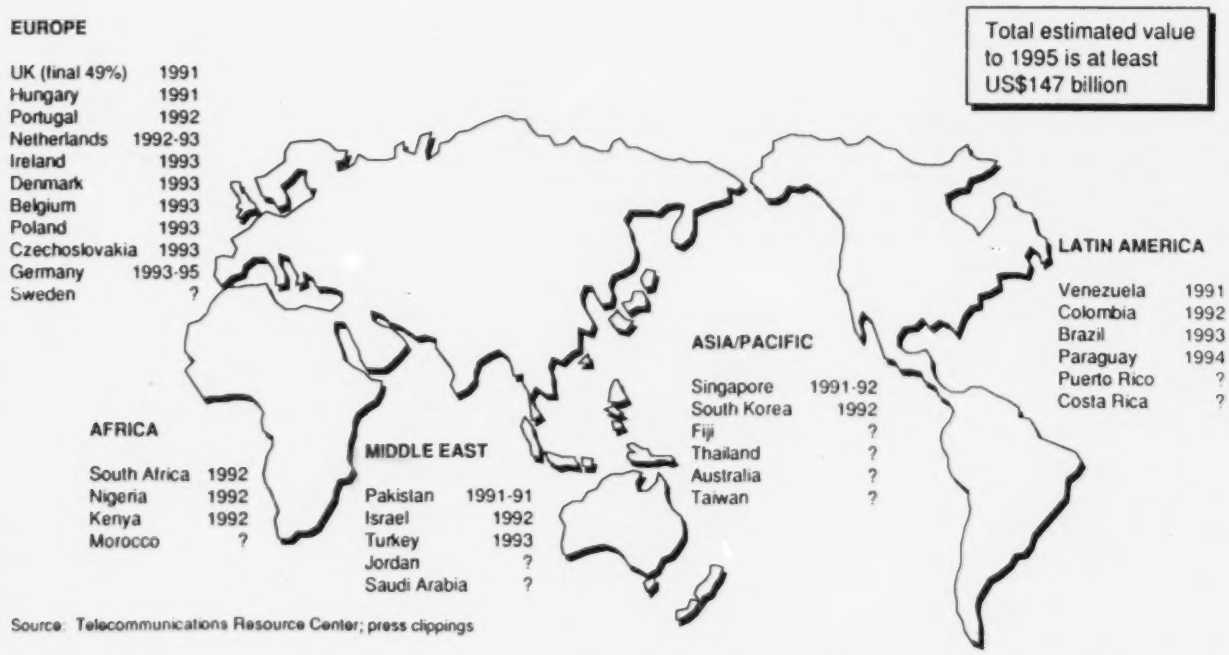
- Identify competitors' likely line of attack and remove potential weaknesses before they can invest

- Develop a deep understanding of customer needs

- Embark on major internal cultural change well in advance of competitive pressures.

EXHIBIT 1

TELECOM PRIVATIZATION PLANS

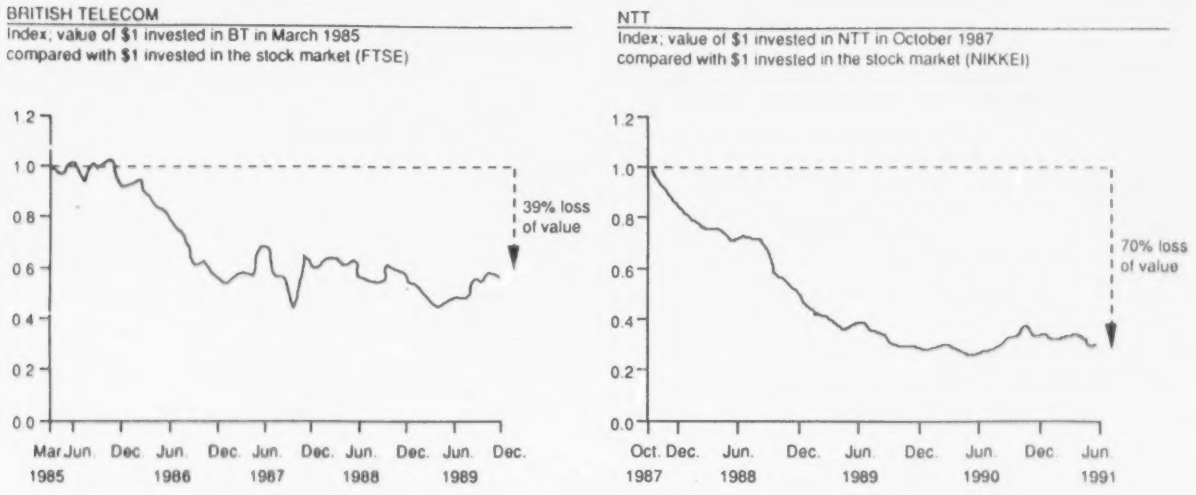


Source: Telecommunications Resource Center; press clippings

710

EXHIBIT 2

CUMULATIVE SHAREHOLDER RETURNS



Source: Reuters; LBS; International Business Task Force analysts; Tokyo Stock Exchange

EXHIBIT 3

INTERRELATED DEREGULATION ISSUES

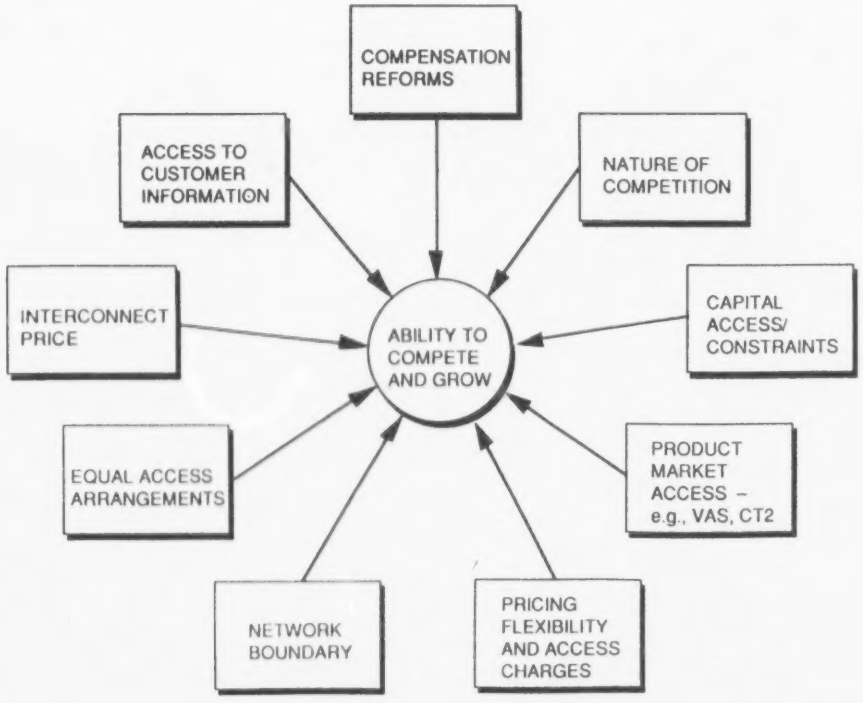


EXHIBIT 4

IMPACT OF REGULATORY PRICE FLEXIBILITY IN JAPAN
Percent

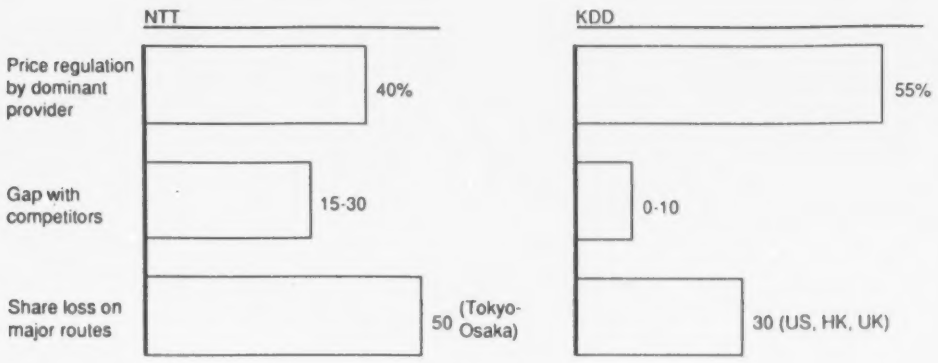


EXHIBIT 5

POST-DEREGULATION CHANGES

AREA	BEFORE DEREGULATION	AFTER DEREGULATION
Focus	– Internal	– External
Key "shared value"	– Technology	– Differentiated service to match customer requirements
Operations	– Driven by engineering	– Driven by enginnering and marketing
Employee performance	– Paternalistic orientation – "following orders"	– Results orientation
Cost	– Low cost sensitivity – Cross-product subsidies common	– Need to manage costs by product/market

7 ± 2

TELEWORK TROUBLES, TRAUMAS, AND TRIUMPHS: CONFESSIONS FROM TELEWORK PLANNERS AROUND THE PACIFIC RIM

by

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1. ABSTRACT

Telework has become increasingly popular in many countries around the Pacific Rim. While there has been much success, there has also been skepticism about how little has been reported about the problems and obstacles. This paper will cite examples of these problems in areas such as employer willingness, union reactions, technology issues, and social, cultural, and public policy areas. A full understanding of these problems is important for telework planners and implementers.

2. INTRODUCTION

Telework has progressed from being an unusual idea to a successful, accepted practice in many countries around the Pacific Rim. While it is by no means common, and its introduction is proceeding slowly, this innovation is no longer just an interesting novelty.

Published reports about telework have been criticized by observers who claim that telework proponents have reported much more about the successes than the failures, and much more about the outcomes than about the difficulties encountered while progressing toward those outcomes. This paper will address these concerns by drawing on the experiences of telework planners and implementers in the US, Japan, Australia and New Zealand.

"Telework" as used in this paper refers to the decentralization of the traditional office, by allowing certain workers to spend part or most of the work week working elsewhere. Other work locations typically include a work area in the home or a "satellite office" at which approximately ten or more workers are located. The satellite office is generally located in or near the residential areas where the workers live, or part way between those areas and the traditional center-city office area.

Most important, we are discussing the regular, routine substitution of these work locations for the traditional office, and we are not discussing so-called "mobile workers" (such as sales representatives or others whose jobs are normally done away from the office) or work done at home during the evening or on an occasional day spent away from the office.

Our goal is to further the understanding of telework by offering a candid discussion about the less-than-successful aspects of the field. The purpose is not to place or take blame, but to balance out some of the existing literature with an assessment of telework problems and challenges. The authors believe that telework is a feasible and practical work method, with potential for much more success than problems as long as it is implemented correctly.

In addition to our own experiences in our respective countries and elsewhere, we gratefully acknowledge the contributions of David Fleming (State of California - US); Paul Chung (Telecom Australia), and Laurence Zwimpfer (Telecom of New Zealand). The comments of these three do not necessarily reflect the official positions of their employers.

3. CURRENT ASSESSMENT OF TELEWORK IMPLEMENTATION

Despite the significant growth in telework, the traditional center-city office is in no danger of becoming empty. The majority of office workers do - and will - work in their offices. While up to 60-65% of the workforce in most developed countries could be classified as information workers (and therefore at least somewhat suited to telework), it is likely that most employers will not exceed a level of 5-10% of their workers as teleworkers.

The interesting and encouraging aspect of telework growth, especially in the US and Japan, is that the rate of growth is increasing. This is typical of many innovations where there is a long, slow introduction period followed

by more rapid acceptance by a wider audience. Within the US, for example, our estimate is that the number of employers who have started new telework programs (whether formal or informal) in the last 18 months is more than the number who began in the previous 3-4 years.

Despite these positive results, telework is far from a widely accepted, widely used practice. In some ways there has been very little cumulative learning, i.e., the same questions or points of resistance that are raised in 1992 were raised in 1982 - even though there are good answers available for these questions. This is frustrating because it suggests that some larger, underlying problems exist that explain the resistance. We hope this paper sheds some light on these problems.

4. SPECIFIC PROBLEM AREAS

We have identified six areas that are part of the telework picture, both when it is successful and unsuccessful. These are listed below as separate problems, but in reality many or most are closely related.

We would like to restate our belief that telework is fundamentally a useful and valuable method for solving some of the problems facing employers, workers, and society. It is impossible to rely only on traditicnal solutions to some of these problems. For example, we cannot solve the traffic and mass transit "gridlock" problems in Tokyo, New York, Los Angeles, Sydney, or other major cities around the world simply by building more roads or adding new train lines. Government funds for these projects are more limited than ever; even if money were not a factor, these new routes would quickly become just as congested as the old ones.

Telework is increasingly making its way into the public policy agendas in the countries cited in this paper and others, as well as being adopted by private employers who are seeking to reduce operating expenses, attract and retain qualified workers, and increase productivity by allowing workers to work in more relaxed settings without having to endure the stress of commuting.

4.1 EMPLOYER WILLINGNESS

The consensus is that employers do not easily embrace telework unless they have a specific reason to do so for which there is no other solution. This is, oddly, both an advantage and a problem. It is an advantage because it reinforces the view that telework should be a business solution to business problems, and should not be used just because of its popularity. It is a problem because it suggests that the more innovative uses of telework are limited if they are not obvious solutions to today's problems.

There were several obstacles noted in our analysis of employer resistance:

A. SHORT-TERM THINKING: Cost-conscious managers required to meet short-term profit (or other) goals are unsure about the cost-benefit ratio for telework. This problem is made worse because the up-front costs are more obvious than the benefits; telework planners have not done a good job in quantifying those benefits.

B. RISK-AVERSE THINKING: Despite all the talk about the need for risk-taking and innovation, we observe that most managers resist change and resist innovation. The relatively rare cases where a high-level manager is a telework "champion" are exceptions; in other cases, it seems that most managers support the idea with words but rarely with their actions.

This problem is most notable in economies like New Zealand, where the last five years of economic decline have forced employers to cut costs – and, unfortunately, innovation – in order to survive.

C. SATISFACTION WITH STATUS QUO: Even though the daily commute and the noise and distractions of today's offices are seen as problems, most managers have become accustomed to them. In Japan, for example, head-office staff is mostly male, with a built-in support system at home (known as the wife) to take care of child care and elder care. Therefore, the consequences of the long commute on the family are not acknowledged as a problem for the manager - so he is unlikely to be motivated to find an alternative. We observe that many Japanese companies aren't resisting telework as much as they are ignoring it, because there is little bottom-up pressure for an alternative.

D. THE "FEAR" PROBLEM: We are grateful to David Fleming for defining the FEAR problem as "False Evidence Appearing Real." In other words, managers are insecure about what they <u>think</u> will happen if they allow or encourage telework, e.g., they will lose control of their workers, be unable to supervise effectively, and lose status themselves.

These entrenched management attitudes are related to Industrial- Age thinking in which managers had to produce a physical product in a factory; they do not fit with Information-Age reality,

and are not supported by evidence from successful telework programs.

E. ISOLATED PROBLEMS, NOT WIDE TRENDS: We see more use of telework in companies facing strong competition in the labor market for skilled workers, because these firms know it helps attract and retain qualified workers. However, these labor shortages are isolated and sporadic - or at least that is the perception. In reality, virtually all Pacific Rim countries now (or soon will) face growing shortages for professional and technical workers.

One reason for these shortages is that employers continue to recruit only from among those people who can and will come to the office five days a week. This eliminates other good workers who could be teleworkers.

F. LACK OF INCENTIVES OR PUNISHMENTS: With the exception of local trip-reduction regulations in several sections of California and other U.S. states, there is no regulatory or financial incentive for employers to adopt telework. Similarly, there is no public recognition or incentive for the employers who use telework - even though it is believed that telework provides public benefits. With neither a "carrot" nor a "stick" available, companies will tend to remain with the status quo.

In summary, we believe that the lack of widespread willingness to use telework reflects complacency and lack of understanding of all aspects of telework and its benefits. To a degree, it also reflects conscious rejection of the telework concept, but we do not believe this is the main reason for low levels of use.

4.2 EMPLOYEE ADAPTATION

Here, we are concerned with the effects of telework on the teleworkers themselves - have these been generally positive, or are there problems that outweigh the benefits?

We believe that problems for teleworkers fall into two categories. First, there are administrative problems - these are generally avoidable but unfortunately they have not been avoided in all cases. Second, there are conceptual problems - these are more serious problems that arise even if telework has been implemented in the manner that reflects the best practice known.

A. ADMINISTRATIVE PROBLEMS include items such as poor selection of teleworkers, poor or non-existent training for them and their managers, inadequate technical support, inadequate guidance about how to prepare the family members for this change, and lack of ongoing support and "fine-tuning" once the program has begun.

These are particularly frustrating problems to telework planners because there are proven and simple solutions. These problems continue because some managers who choose to implement telework do so with very little, if any, planning. This is a prescription for failure, and very often it is the teleworker who fails.

Some of this relates to the personality of the manager, but it also relates to the age gap between managers and their teleworkers. For example, many Japanese men in their forties have difficulty using a photocopier, let alone a PC. Thus, when it comes to helping teleworkers equip themselves, or communicating them over a distance via electronic mail, the managers cannot perform. The result is poor performance and frustration for the teleworkers.

B. CONCEPTUAL PROBLEMS are more complex. For example, these include the question of how and whether telework will affect the career progress of teleworkers. Informal evidence in the U.S. suggests that teleworkers are at least as promotable as before, mostly because they learn and use new skills that qualify them for promotion, and because their work is now more visible than before. But the perception lingers that being "out of sight" is "out of mind" for the next promotion.

In Japan, it is impossible to draw any conclusions yet because of the early stages of experimentation. We expect, however, that the career progress issue will be a problem because of the difficulty in doing performance evaluations even in the head office. This will become even more strained if teleworkers are separated from their managers.

We would like to note that the broader question of career progress in today's flattened, "downsized" organizations means that our old assumptions about upward mobility must be changed. We have heard from teleworkers who say that they welcome the privilege of being allowed to telework because it is a more certain form of "reward" than the uncertainty of upward mobility. For them, telework is a type of career progress and development; this is in addition to the personal and family benefits it offers.

In some of the countries studied, much of the interest in telework comes from the self-employed (for whom home-working is the most sensible economic choice), and from salaried teleworkers doing so

informally because of lifestyle benefits. We believe this kind of grass-roots interest in telework is strong support for the view that it is a preferred style of work for some.

4.3 UNION REACTIONS

At best, unions have been skeptical about telework; at worst, they have been openly resistant. Much of their reaction is based on the history of abusive industrial home work around the world. To their credit, the unions have fought hard to restrict or eliminate this. But we believe that Information-Age telework is quite different from the old-style home work.

It appears that union reactions are sometimes based on lack of knowledge about telework. In some cases in the U.S., for example, union leaders have not accepted invitations to be involved in early briefings or planning sessions for telework pilots. In other cases, they have made initial demands that reflect their lack of understanding about telework. For example, one California union wanted teleworkers to be selected based on seniority - with no regard for job performance, type of work, or other factors.

In Japan, it should be noted that unions are company unions and not trade unions, and there is not the kind of adversarial relations as sometimes exist in trade union settings. Japanese unions appear to have taken the position that as long as there is equality in allowances (e.g., for housing or urban living costs), there is no great problem. In the NTT telework pilot, for example, teleworkers have been placed on long-term business trip status for administrative purposes, so they can continue to receive their urban living allowance even though they would no longer qualify for this allowance based on the suburban location of their satellite office.

Perhaps the biggest concern of unions is that telework will lead to (or is part of) a plan to convert regular full-time workers with full benefits into part-time or contract workers with lower wages and reduced or no benefits. It is this fear about the loss of hard-won wages and entitlements that motivates resistance, as well as the related fear that it would be harder to organize and represent a dispersed, decentralized workforce. Unions derive much of their power because of their collective strength; to a degree, this depends on workers being together in groups.

Further, some unions have expressed the concern that the selective nature of telework (i.e., it is a specific kind of job assignment open only to some workers) contradicts the basic union principle of equity and equal treatment. In Japan we have seen companies spend a lot of money to set up and furnish satellite offices; the money saved on lower-cost satellite office floor space more than justifies this expense. Thus, the work environment there is often better than in the head office. While this is clearly a benefit for the satellite office workers, it does put them in a position with slightly higher status. It will be interesting to see the union reaction if and when telework spreads in Japan and we see less elaborate satellite offices.

Another factor is the timing and degree of union involvement in telework planning. We believe that this is one of the best predictors of acceptance by union leaders. In cases where the employer planned telework with the union - and listened to its concerns and suggestions - the project went more smoothly. In cases where it was done with only minimal union involvement, there were, understandably, more problems and more resentment.

4.4 TECHNOLOGY ISSUES

We believe that there is a gap between what has been promised or advertised about technology and what actually is available at reasonable cost. There is no doubt that there is adequate technology to handle many telework applications today, but there are some technology "thresholds" that have not yet been crossed.

One particular concern in Japan is the diversity of computers and word processors available. In the U.S., Australia, and New Zealand, the IBM and Macintosh standards are quite common; in Japan, PCs from IBM, Fujitsu, Oasis, and NEC are widely used and don't communicate with each other - not to mention an even wider range of word processing equipment. This makes it hard to set up telework unless the equipment is all from the same vendor.

Apart from the equipment concerns are the bigger problems of telecommunications connections. Dial-up charges in the U.S. can be very costly for teleworkers who spend much of the day connected to mainframes or LANs at the office; this is complicated by having to use transmission speeds of 2400 bps or less. The much-heralded ISDN should make these and related problems shrink if not disappear, but ISDN is not yet widely available in most Pacific Rim countries - with Australia being a notable exception.

There is also a problem with determining fair and appropriate line charges for teleworkers. Neither one of the traditional classes of service (residential or business) fits the teleworker; innovative phone companies are starting to offer a new class of service for certain telework applications; this should be an attractive (and cost-effective) strategy.

A related problem is the spread of technology vs. the spread of teleworkers. Whether they are working at home or in satellite offices, teleworkers who work in suburban or rural areas often don't have access to the same telecommunications services as in metropolitan areas. This is, obviously, because the telephone companies make their first investments in new technologies where the population density is highest. This sets an effective limit on the amount of dispersion via telework.

There are other technology problems for which solutions are available but either costly or underutilized:

A. DATA SECURITY: The objection is often raised that some jobs are too confidential to be done away from the head office - yet in these same companies, an office worker can carry out computer printouts or diskettes with the same "secure" data in his or her briefcase without being challenged. Also, there are elaborate monitoring systems in place to detect and record unauthorized attempts to dial into company computers from a remote site - yet the reports generated by these systems are sometimes not reviewed to determine if these unauthorized attempts were made.

The irony is that the same company that has these kinds of security failings will be critical of telework because it supposedly presents a major security risk. This is not necessarily the case, but the belief prevails and is one more reason why telework is not permitted.

B. UNPREDICTABLE LINE QUALITY: For certain telework applications where reliable, high-speed data transmission is a requirement, the use of existing local-loop, voice-grade phone lines is a risk. These include applications with frequent transfers of large files to and from the mainframe, or teleworkers who handle incoming toll-free calls (for travel reservations or catalog ordering). If the employer must pay for a separate leased line to be sure that the teleworkers can work without inconvenience, the cost of telework goes up substantially.

C. USER-UNFRIENDLY COMPUTERS: Despite all the advertising about "user-friendly" computers, the fact is that many PC applications are not quite as simple as we would like. With the exception of the small number of true PC technical geniuses, most of the rest of us run into problems quite regularly. If we are in the office where we can turn to a colleague - or a nearby genius - we can solve these problems.

If we are teleworking, we can still "turn" to the expert by making contact via telephone, voice mail, or electronic mail. Also, a few telephone companies are starting to provide online and/or call-in support support services for teleworkers. These solutions aren't quite as easy but they do work.

The problem is not with telework itself but with trying to use hardware and software that is still considerably more difficult than using a VCR or microwave. The growth of Macintosh sales and in Windows-based applications for the IBM world should help this problem, but it won't go away overnight.

D. VIDEOCONFERENCING: Last, we must make mention of this tool and its role in telework. It is often cited as the most important innovation because it will allow the kind of face-to-face contact that we are accustomed to when everyone works in the office. The last 2-3 years have seen a dramatic increase in videoconference capabilities with a decrease in costs - these are two favorable trends. However, it still is not as simple as turning on our TV set at home to watch our favorite show.

We believe that videoconferencing does have a role in the growth of telework, but that for the immediate future it will be used on an exception basis and not very routinely. We do not believe that this is an obstacle - in fact, there are many cases today where simple audio conferencing is being used very successfully to bridge the distance between the telework location and the head office. But the obstacle is the perception of managers that the video portion is needed. This reflects the Industrial-Age thinking that says, "If I can't see them, how will I be able to communicate with them or know that they are working?"

4.5 EFFECTS ON HOME AND FAMILY LIFE

Even though many employers claim that they are not interested in their employees' home and family lives, the reality is that they cannot ignore this completely. Telework can have a major effect on home and family life, though this is more common in the work-at-home form of telework. Since very little of this form occurs in Japan (due primarily

to smaller home sizes), and because small home sizes in other Pacific Rim countries will pose similar problems, we will comment mostly about the American experiences first.

One advantage of commuting to the traditional office is that the boundary between home life and work life remains clear. However, when the teleworker lives and works under the same roof - even if only for 2-3 days each week - this boundary becomes unclear. In some cases this creates unexpected benefits - and in others it creates unexpected problems. The benefits (such as more time available with other family members) have been widely reported elsewhere and will not be covered here.

Two of the potential problems are as follows:

A. RISK OF OVERWORKING: It has been said that home-based telework can be the "workaholic's dream." When we eliminate the commute, the workaholic can work almost unlimited hours. This may seem like a benefit to the employer, but we must remember that these hard workers sometimes burn themselves out - and create serious strains within the family as well.

B. CREATION OF NEW HOUSEHOLD TENSIONS: In every household there is a division of labor. We would observe that this division is rarely completely satisfying to all household members. Telework allows a reassessment of this division, but this sometimes creates more problems than it solves if the teleworker is expected to take on more household duties. For example, consider the teleworker's spouse who comes home from the head office and says to the teleworker, "Why haven't you prepared dinner - you were home all day!"

When looking beyond the U.S., we note that the phrase "home and family life" has a very different meaning in Japan and in other Pacific Rim countries. In Japan, for example, long absences by and little contact with the father are the norm. Some people we consulted in Japan went so far as to say that family life doesn't exist in the modern corporate worker's home!

The satellite office worker in Japan may be able to spend more time at home in the early morning and early evening because of reduced commuting time, even though he does not work at home during the day. This can open up new possibilities in family relationships - but these relationships can have their own problems as the family tries to adjust to this new pattern.

One teleworker in Japan told us that he had more time with his family when he was assigned to a nearby satellite office - but when he was sent back to the head office it was very hard on his children. They could not understand why their daddy wasn't taking them to the bus stop in the morning any more. Telework planners caution teleworkers that they should not make any permanent changes in habits or lifestyles at home if their telework assignment is likely to be temporary, as it often is. However, problems like this "bus stop" adjustment are not uncommon.

In summary, we have seen many cases where home and family life have improved greatly because of telework - in fact, this appears to be the norm. But there are cases where there are as many problems as improvements. Whether it is home-based or satellite office telework, employers must help their teleworkers understand what kinds of changes might occur and how to cope with them. This type of training and support has not been provided as often or as widely as needed.

4.6 SOCIAL, CULTURAL, AND PUBLIC POLICY ISSUES

This is a broad category of concerns dealing with population dispersion, the relative merits of urban vs. rural life, the effects of telework on the communities, the role of the auto as the main commuting method, and the desirability of adopting new models of regional planning.

One factor that affects telework growth is the presence or absence of government policy to encourage or restrict that growth. In the Pacific Rim countries there is a wide variation in the level of interest and involvement by various government agencies. As we reported in our 1991 PTC paper ("Contrasting Roles of Public Policy in Telework Development in the United States and Japan"), the telework concept is just beginning to make its way into the vocabulary of government planners. This is a slow process but we have seen dramatic improvements during 1991 and expect this to continue.

We note the following issues as impediments to telework growth:

1. DOMINANCE OF THE CENTRAL CITY AREA: Despite years of growth in suburban areas, the traditional "downtown" areas are still seen as the focal point of business and government activity. There is a large infrastructure in place that reinforces this idea; mass transit, for example, has been designed to move people from suburbs to downtown, not from suburbs to suburbs.

There is also the perceived status of being located in the prime commercial district. Companies that are interested in satellite offices sometimes find that their workers do not want to work at those "remote" locations because they fear that their status (in the eyes of colleagues or competitors in other companies) will be decreased.

2. URBAN SPRAWL VS. RURAL DEVELOPMENT: In the U.S., the concern has been raised that telework will encourage more people to move even further away from the cities to areas too distant for easy commuting but very suitable for teleworking. Critics claim that this will spread the ills of urbanization even further out into the unspoiled countryside. By contrast, in Japan we find that this kind of spread is exactly is what is needed to deal with the over-concentration of people and jobs in metropolitan Tokyo. The rural areas could benefit greatly from this kind of dispersion of work as a means of rural economic development.

With the exception of some preliminary work being done by the National Land Agency in Japan, we do not see any signs that land use planners in Pacific Rim countries are making efforts to include telework in their planning. One possible exception is a recent comment by Gordon Campbell, Mayor of Vancouver, British Columbia. He said that "the day of the traditional bedroom community is gone ... we can no longer afford that kind of separation between living and working areas. It's just not realistic or desirable to expect downtown Vancouver to be the single job center for seventeen municipalities in this region."

3. THE DOMINANCE OF THE AUTO: It is often noted that Americans (and Californians in particular) are married to their cars; the single-occupancy vehicle is still the main commuting method in many areas, despite extensive traffic problems. Even after year after year of increasing traffic congestion, we still hear that governments are ready to spend more money to build new roads or widen existing ones. So-called "smart highway systems" are now suggested as high-tech gridlock solutions, yet these multi-million dollar experiments are unproven and do nothing to deal with the underlying problem of too many cars on the road.

Similarly, mass transit programs are not the complete answer. These presume the kind of suburb vs. center-city separation that may no longer be desirable. Also, cities like Tokyo or New York already have extensive mass transit systems in place; they are highly utilized during peak commuting hours and cannot be expanded without incurring huge costs.

We are troubled by the fact that transportation planners have not gotten the message that spending only a portion of the cost of a new subway line or expressway could pay for the start-up costs for thousands of teleworkers. The net cost to society of continuing to transport millions of workers is overwhelming, yet we continue to look for new ways to move the workers instead of moving the work itself electronically.

Government policy in many countries seems to evolve from reaction to crises, not from careful planning. In the U.S., for example, the Interstate Highway System was "sold" based on our presumed vulnerability during and after World War II, not because of a forward-thinking national transportation policy. Similarly, we saw a great deal of ad hoc telework develop in San Francisco after the 1989 earthquake, and some observers note that an even higher level of telework would be evident if there was another Arab oil embargo.

We do not want to imply that we welcome these disasters or disruptions. The problem is that the "crisis" created by today's tradition of commuting is much less visible and much less immediately painful than an earthquake or oil embargo. The cumulative effects of gridlock, air pollution, disrupted family lives, and reduced productivity simply aren't the kind of issues that politicians can rally around.

What is worse is that powerful economic and political forces exist to maintain the status quo. The auto, oil company, office and highway construction, and mass transit construction industries all exert significant pressure on governments; any serious attempts to promote telework would likely be met with strong resistance from these industries. By contrast, the telecommunications and computer industries have not been able to get as much attention from politicians, though this is starting to change.

We believe, therefore, that telework growth will be largely a private-sector activity. (The popularity of market-based economies - with minimal government intervention - is one reason for this belief.) Public policy can be used selectively to encourage this growth - and perhaps to stimulate it with low-cost tax incentives. It is more likely that satellite office telework will attract the attention of government planners because these facilities are more tangible and visible than at-home telework. Also, networks of satellite offices for up to several hundred teleworkers each will have a much greater effect on traffic congestion and air pollution - and satellite offices

are likely to be the predominant form of telework growth in many Pacific Rim countries where residences are too small to accommodate a dedicated work area.

5. CONCLUSIONS

The dilemma of telework is that we know it works - and works well - where it has been implemented correctly, yet it has not been as widely accepted and utilized as expected. If it were not for the fact of the very positive evaluations from teleworkers and (more importantly) their managers, we would be less optimistic about telework's future.

The problems described in this paper are typical of problems that arise when an innovation is thrust in the middle of tradition. We must remember that "going to the office" is a part of the language all around the world. When the office becomes a spare room down the hallway at home, or a comfortable workstation in a nearby satellite office, we have done more than change the language. We have begun to tamper with long-established norms and policies, and whenever that happens we can expect resistance.

We continue to believe that telework will become accepted as a legitimate and beneficial work method. It will not replace the traditional office, and we all will not be working at home in our blue jeans.

The growth and economic vitality of the Pacific Rim countries depends on having a steady supply of qualified, productive workers, and on a quality of life that is not threatened by gridlock, pollution, and vast differences in urban vs. rural economies. Telework is one method to help insure this vitality, and we look forward to continued progress in overcoming the kinds of problems noted in this paper.

A TRIAL OF TELEWORKING AND TELELEARNING
— Practical approach in the communication software field

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1. ABSTRACT

Out of our commitment to telecommunications software development as a teleworking model over the last few years, we have set up teleworking offices in eight cities throughout Japan. This paper focuses on two issues, teleworking, of the transmission of informal or contextual information among distributed offices and the improvement of teleworking. It proposes a communication system for teleworking and a telelearning system for improving the capability of teleworkers. The key for this purpose is to transmit business-oriented information, as well as informal or contextual information for the good relationship among teleworkers at distributed office.

2. STATUS OF JAPANESE TELEWORKING

2.1 WHY IS TELEWORKING NEEDED?

The continuing convergence of population in the metropolitan city of Tokyo has led to a host of annoying problems, such as rising land prices, high rents for office space, long commutes, a housing shortage and air pollution. Organizations such as the Ministry of Posts and Telecommunicatuins, the Ministry of International Trade and Industry (MITI) have been working on experimental projects for better office distribution. On January 30, 1991, the "Japan Satellite Office Association" was founded by 21 business entities. This foundation is aimed at promoting the development of offices outside the Tokyo metropolitan area. These has been serious discussion in Japan, on the need to distribute offices and encourage teleworking. This argument is supported by the following observations:

(a) Problems caused by the concentration in Tokyo
- Increase of land prices
- Housing shortage and long commutes
- Traffic jams and air pollution
- Shortage of public facilities for residents

(b) Changes in employment structure
- Shortage of young workers
- Improvement of social status of women
- Reduction in working hours
- Return to hometowns

(c) Social problems
- Insufficient space and office buildings
- Aquistion of excellent human resources
- Housing shortage and long commutes

(d) Individual requirements
- Comfortable office environment
- High-quality work at own pace
- Changes in sense of value (More emphasis is put on individual life style than on the company)

2.2 CLASSIFICATION OF TELEWORKING

In Japan, teleworking has been experimented with on a trial basis. The following teleworking styles are proposed.

(1) Home offices linked via telecommunication
(2) Suburban satellite offices (Offices and housing are close to each other)
(3) Satellite offices in regional cities
(4) Resort area offices (Offices and resort area are close to each other)

Up to now, writing, translation, building design and a few other types of work have been carried out in offices at private homes. The telecommunication technology has promoted working at home.

Some people work in satellite offices in the suburbs near their homes. This work is aimed at solving the problems of insufficient office space in downtown Tokyo, and freeing people of long commutes.

The third concept is to set up satellite offices in to major regional cities connected by a high-speed digital network to allow the same activities to be deployed at each of them. Setting up offices outside Tokyo not only contributes to the development regional areas, but also enables more engineers to be employed. This idea is expected to work well in Japan.

Resort area offices is another idea which should work well in Japan. People work at offices located in resort areas for a certain period depending on the purpose, usually three days to one week, or at most one month. These offices will complement other distributed ones.

2.3 OUR APPROACH

Fujitsu's communication software division has implemented teleworking in offices at major regional cities. Eight local offices have been set up to practice various approaches aimed at improving the worker environment, improving software productivity, and implementing of properly distributed programming environment. Given below is a description of our concepts and requirements for a teleworking environment.

Concepts
- Comfortable working environment
- Smooth communication among distributed offices
- Performance of the same business activities as at the centre office
- Achievement of higher productivity than at the centre office

Requirements of teleworking offices
- Location in the downtown areas of regional cities
- Extension and implementation of integrated telecommunication network
- Easy accessibility
- Implementation of functions for improving the quality of life

Teleworking environment
- Assignment of one workstation and telephone per teleworker
- Installation of LAN plus server facilities
- Sufficient office space
- Enough review rooms, large enough break area

We have also been promoting an "Excellent-Work-Way" (E-W-W) that targets the work style allowing individual creative capability to be drawn out fully. "E-W-W" is expected to spur teleworking. The concept of "E-W-W" involves flexible working at an individual's own pace. It is aimed at implementing rapid flat communication via electronic documents rather than face-to-face communication. It is also intended to build a data base containing design know-how so that everyone may share design data and information in any office. The following goals must be met:

Implementation of comfortable office environment
- Extend and improve office space containing physical facilities such as data telecommunication equipment, as well as to carry out concentrated working and construct a relaxing environment. Interruptions such as the ringing of telephones will be reduced and jobs will be embarked in at an individual's own pace.

Effective use of non-realtime communicaton
- Apply non-realtime communication means allowing each person to work at their own pace as well as realtime communication like telephone, and to set up the corresponding work style.

Location independence access to data and information
- Allow each workstation on engineer's desk at any distributed office to access needed data and information as well as the centre office.

3. COMMUNICATION AMONG DISTRIBUTED OFFICES

Discussed first in this Section is "communication among distributed offices" as a major issue of teleworking. Such communication depends on the information to be transmitted in the process of software development, on the strategy of transmitting the information, and on the communication system to be used. Further, we must take into account what is insufficient information and what system supports it.

3.1 COMMUNICATION ANALYSIS

One of the requirements for encouraging teleworking is that we understand the contents and characteristics of communication among offices engaged in developing distributed software. Communication can be investigated by the following methods:

(1) Analysing processes of software development to survey communication derived in each process
(2) Surveying dynamic information flow among offices

(3) Sampling contents of work by engineers
(4) Conducting a survey by passing out questionnaires to engineers

The clear definition of the development process is important for improving the productivity and quality of software development. It is thus necessary to clearly understand communication in the development process. A survey of dynamic information flow will help to identify unexpected communication not covered in the development process. Modeling communication on the basis of the results for the above investigation will contribute to determining what communication means are needed and what working style is appropriate.

Using above method (2), we have investigated into what communication is carried out in the distributed office. Here are the results of this investigation. We focused on engineers engaged in developing software at the distributed office. Data on the contents of communication over telephone and facsimile. Figure 1 shows some results, which tell the following:

(a) Communication is carried out more frequently in certain places, especially the centre office. More than 90 percent of the communicators are personally acquainted with each other. This communication is thus supported by friendship.

(b) Overseas communication is carried out more frequently by facsimile than by telephone due to time differences.

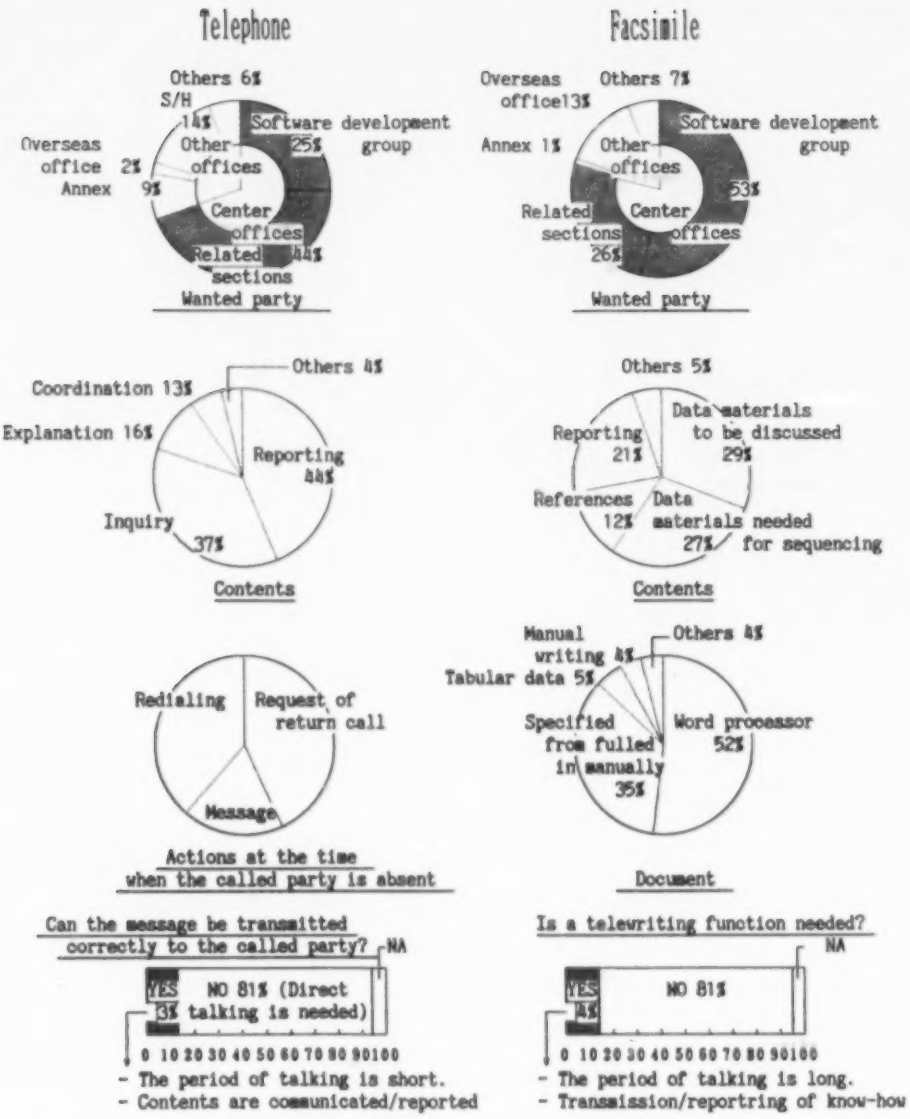

Figure 1 COMMUNICATION AMONG DISTRIBUTED OFFICES

(c) In most cases, communication by telephone requires direct talking; If the called party is absent, 80 persent of the callers will redial later or request to be called back. This means that, in many cases, a function for recording a message is less important than an indication that the called party should dial the caller.

(d) The type of information sent by facsimile includes design documents and progress report data. These documents and data can also be transmitted by electronic mail system (E-mail).

3.2 INVESTIGATION INTO TELEWORKER'S CONSCIOUSNESS

The questionnaire (Figure 2) targeting teleworkers tells that their anxiety and dissatisfaction is related to the items below.

[Young teleworker]
- Difficult to acquaint with staff members in the centre office and feels constraint in asking questions.
- Does not know who to ask a question to.
- Wants to visit centre office.

1. Problems of distribution

(1) Time lag of information transmission, loss of chance, and time loss
- No information can be accessed timely.
- It takes a long time to get an answer.
- Information transfer takes a long time.
- Difficult coordination covering three bases or more is required.

(2) Inaccessibility to atmosphere and situation
- No information of related project development can be acsessed.
- Complicated contents cannot be transmitted.
- It is difficult to communicat with people you are not acquainted with.
- Troublesome coordination of job request.

(3) Access to shared information
- It is defficult to acsess information recorded on paper.
- It is troublesome to register and acquire resources shared on programs.

(4) Taking part in an event
- It is difficult to participate in exhibitions and public conferences.
- It is difficult to participate in events such as meetings of professional societies.
- It is difficult to learn new technology.
- A new product is often demonstrated in the center office.

(5) Business trip required
- Some jobs can be covered in a distributed business office.
- Some business trips are not successful.

2. Drawbacks of telecommunications

(1) Conference by voice transmitted by telephone
- In some time zones, many lines are busy.
- The called party cannot be caught.
- Communication by only voice results in insufficient explanation.
- Reactions of the related party cannot be indetified.

(2) FAX
- In many cases, the called fax is busy.
- Whether the message has reached the called party cannot be known.
- Transmission is not always successful and documents are sometimes difficult to read.

(3) Others
- there is not enough means to transmit his (her) comments using images and video.
- Different data forms on the computer requires troublesome conversion.

Figure 2 DISSATIFACTION/ANXIETY OF TELEWORKER

- Seldom takes part in exhibitions, seminers, and meetings of professional societies.
- Seldom knows cutting-edge technology and is prone to suffer from lowered consciousness.

[Leading teleworker]
- Not informed timely of actual development status at cntre office.
- Must make frequent business trips.
- Less stimulation makes it difficult to encourage new.
- Young teleworkers have no critical consciousness of problems.

The required environment must thus compensate for a handicap of working at teleworking offices far from the centre office. Taking on a mental role, this compensation not only allows the performance of jobs independently of the place but also provides solidarity among distributed offices.

3.3 ROLE OF INFORMAL COMMUNICATION

Taking into account only formal information such as design data and programs, the network manager is apt to build a "cost-saving" network. However, communication by persons in the same office, face to face communication plays a very important part. Informal or contextual information is needed for three reasons. The first is to complement the communication of formal information. Members of a working team need to receive information not covered by formal documents including the past processes and background information. The second reason is concerned with psychological elements. Supplying informal communication helps eliminate the separation and the mental stress that all information may not be received. The third reason is the development of engineers. In-house traning such as OJT is quite useful. Observing the job performance of a role model and learning to understand different points of view leads to unconscious development of the member.

The performance of jobs in distributed offices entails the disadvantage that such communication is difficult. The disadvantage leads to a discussion on the comparison of non-pertitioned offices and pertitioned offices. A non-pertitioned office has the advantage that everybody can understand one another by the various types of information in the office. However, work is hindered by frequent interruptions. Thus, a non-pertitioned office is

not well-suited to work requiring high concentration. In contrast, a pertitioned office makes an individual work more efficient, but it leads to other consideration for matching consciousness of individual engineers with each other. For this consciousness integration, conferences must often be held and reports must be circulated frequently. In addition, supporting space including lobbies, and common areas such as meeting rooms are needed to supplement communication.

A future issue consists in identifing what communication system is geared to a certain type of informal communication. If such information can be transmitted with well controlled, distributed offices will be an efficient environment inherited advantages of both offices.

4. COMMUNICATION SYSTEMS FOR TELEWORK

This section discusses a communication system for supporting teleworking on the basis of the above achievements of communication analysis.

4.1 COMMUNICATION SYSTEMS FOR TELEWORK

Figure 3 shows the currently available communication systems. Video conferencing system and telewriting system are such that telephone and facsimile are extended to cover conferences. The video conferencing system calls for ISDN covering 64 kbps to 384 kbps. But the telewriting system can be used over an ordinary 9.6 kbps telephone circuit. Which system is used will depend on the applicability to communication and the line cost.

The electronic mail system (E-mail) system as well has been propagated rapidly in Japan. This propagation stems from the increasing use of Japanese word processors and desktop computers. The E-mail communication system has some features not provided by other systems. Information can be accumulated, thus allowing engineers to exchange

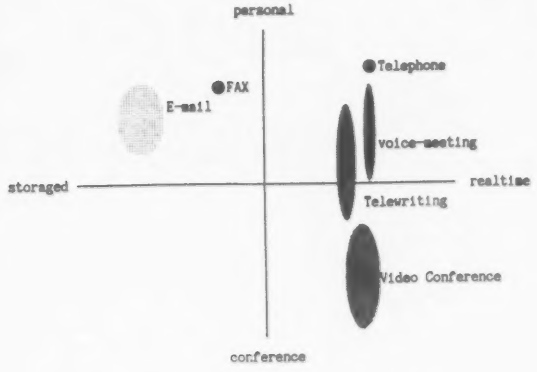

Figure 3 COMMUNICATION SYSTEMS FOR SUPPORTING TELEWORKING

their information at their leisure. Currently, there co-exist commercial base communication systems using personal computers based on telephone lines, in-company mail systems using LAN (Local Area Networks), and UNIX mail systems using by UNIX engineers. Thus, higher effects will be achieved, if mail systems can be interconnented by a mail transfer function or if an integrated user interface can be implemented.

4.2 SUGGESTION OF SUPPORT SYSTEMS FOR TELEWORK

We propose a distributed network which integrates a network transferring data for software development support tools and a network for supporting inter-office communication. Figure 4 shows the configuration of the system. Most of CASE (Computer Aided Software Engineering) tools are aimed at making it more efficient to design, manufacture, and test software, and at integrating and supporting these processes. These tools are short of the aspect that communication is supported on the basis of a development process. This field has been understood with the help of a concept of GROUPWARE or CSCW (Computer Supported Cooperative Work). The groupware deals with human interaction to support the cooperation of a business group. Sample achievements of groupware include:

- Multi media computer conferencing system that integrates voice and video at a workstation
- Common editor that allows staff members to cooperate with one another in preparing and reviewing design documents
- Computer-aided conferencing system which supports decision from discussion
- Dispay wall to support the tranmission of informal information

The new form of communication backed up by groupware technology as well as by computers and communication equipment will make the teleworking environment more comfortable.

In the future, the development of communication technologies such as a broad band ISDN will allow the supply of service which has been difficult to implement in the past owing to line speed and cost.

5. INTRODUCTION OF TELELEARNING

5.1 ENHANCEMENT OF TELEWORKER'S CAPABIRITY

The success of education depends on the growth of the consciousness of self-development. The above investigation into consciousness tells that it is important for the teleworker to master knowledge and engineering, as well as to receive stimulation and motivation. More emphasis should be put on the arrangement of a system of common lectures over distributed offices than on the performance of closed education at sites. Important is an increase in the chance for enhancing teleworker's capability through the systematization of education and training from the standpoint of integrating all sites.

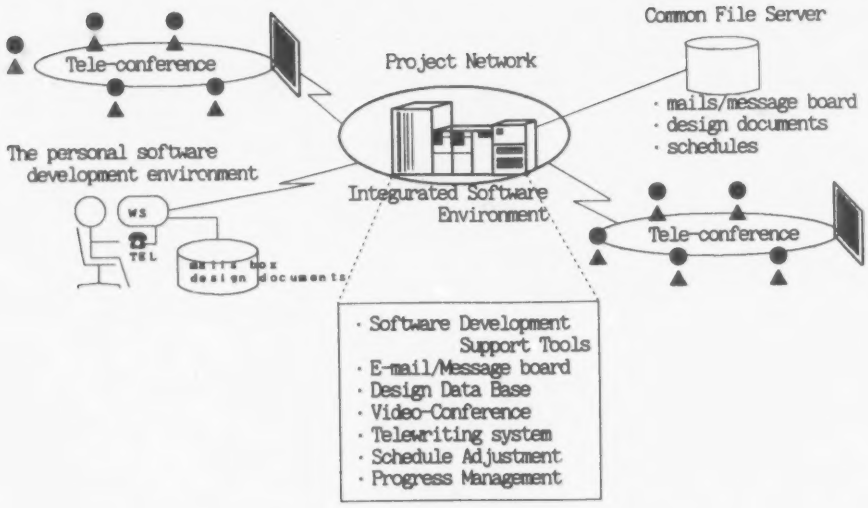

Figure 4 INTEGURATED SUPPORT ENVIRONMENT FOR TELEWORK

5.2 APPROACH TO TELELEARNING

The purpose of implementing telelearning is to carry out the education and training of a large number of people without the need to make a business trip. The telecommunication technologies has allowed remote access to an educational lecture that is held at centre office. in telelearning, the lecture need not make any business trip. Telelearning provides not only the primary effects of a lecture, but also secondry significant effects in that teleworkers are motivated and stimulated and provided with solidarity as a group working at each office.

5.3 TELELEARNING SYSTEMS

This subsection introduces training based on a video network system as an examples of telelearning and a remote CAL(Computer Assisted Learning) system.

Fujitsu has built a video network system linking distributed offices, factries and sales branches, and laboratories. The system serves various purposes including remote lecture. A lecture at a hall or studio can be listened to simultaneously at the sites by means of satellite links. The installation of a large-scale receiver consisting of a projector and the trandmission of realistic sound as if teleworkers were at the hall or studio and the capability of asking questions to the centre from the sites are essential for this system.

The remote CAL system is superior to the standalone system in that exercises to be supplied can be changed flexibly to the level of an individual learner. The remote CAL system does not supply learning materials in the form of floppy disk, different from the standalone CAL system, but delivers them directly over an ISDN line. Collecting results of learning by users allows effects to be fed back to the learner and the learning material developer. A large-capacity disk at the centre computer and high-speed transfer by ISDN have allowed the timely supply of coursewear and new learning materials.

5.4 TELELEARNING USING DISTRIBUTED DEVELOPMENT ENVIRONMENT

We suggest telelearning based on a network environment for distributed software development. It intergrates a telewriting system for a remote conference, a video-conferenceing system, and desktop workstations connected over a network.

The proposed system allows communicative learning via one workstation assigned to each teleworker, and lectures and training based on a video-conferencing systems. Figure 5 shows a system image to be implemented.

The following are the requirements for implementing this systems:

Object of telelearning
: Identification on whether or not telelearning is geared to the object.

Operabirity
: It is desirable that special operations not be needed.

Bidirectivity
: Features including automatic answering should ease the burden on the manager and supply of a system accumulation questions as well as accommodating online anawering.

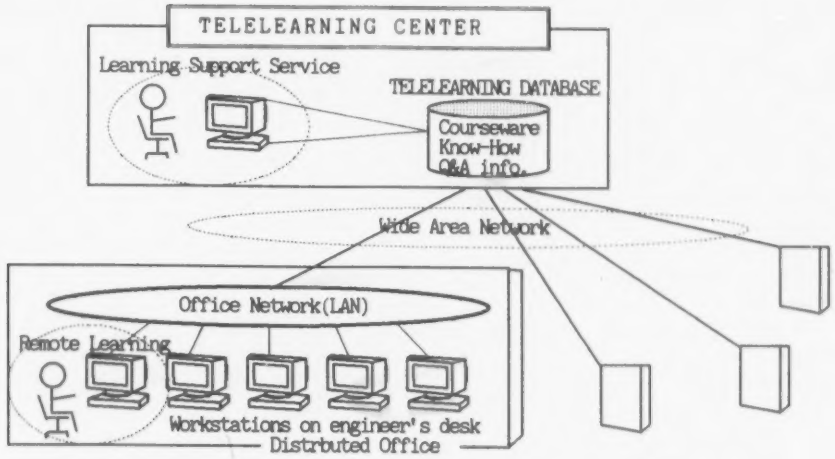

Figure 5 TELELEARNING UTILIZING DISTRIBUTED DEVELOPMENT ENVIRONMENT

Motivation and stimulation of learner
The telelearning with the level and at an appropriate pace of each teleworker, and promotion of making human relationships through communications among learners.

Protection of privacy of learner
The results and records of telelearning must be handled confidentially.

Evaluation of effects
Achievements must be evaluated qualitatively and quantitatively.

6. SUMMARY AND FUTURE ISSUES

Undoubtly, business offices will be distributed slowly but steadily. It will become a essential technology in the future to develop the software with distribution. The rapid progress of distibution calls for supporting of informal communication between distributed offices and the facilities which allows teleworker's capability to be enhanced.

The advent of a new telecommunication service provided possibly by broad hand ISDN in the future will lead to the implementation of diverse telecommunication systems supporting teleworking. Recently, a commuter train without seats introduced on trial in Tokyo has been used to relieve congestion during rush hour. Incidents of handling commuters as cargoes has been reported on the TV news. It has posed a human mental problem that cannot be solved using only efficiency and utility. A future highly adovanced telecommunication system must be able to deal with human paychological aspects including human-machine interface.

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TELECOMMUNICATIONS, INFORMATION TECHNOLOGY AND THE NEW ORGANIZATION -- AND YOU

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ABSTRACT

Telecommunications and IT are having profound effects on the nature and shape of organizations. There are already certain indications of what lies ahead -- including people's roles in the changes. The paper explores these issues and outlines directions to pursue to influence organizational destinies.

1. INTRODUCTION

Organizations and their structures are undergoing significant change under the impact of information technology. They have always needed to respond to such influences. But the effects of telecommunications and computers are proving so far-reaching that we can expect major shifts in business, government and related institutions in the future across areas that will affect us all. And those who plan for this will cope best with customers, competition and community demands -- and their own careers.

Just what will happen will depend not only on the vagaries of the future but also on which organization and which area. Indeed there is a need, as in this paper, to consider many diverse developments so as to appreciate what is happening and which indicators of future directions we all should be watching.

2. WHAT INFLUENCES?

What organizational influences are we talking about? One of the earliest and most significant was the telephone. With that one development whole new ways were created for linking people and organizations together. Messengers were suddenly not needed; travel could be reduced; and it became possible for activities to move away from the one site i.e. to be decentralised as never before.

Information also began to move at unprecedented speeds. Theoretically so did decisionmaking -- although this "immediate" information encouraged top managements to get involved in the decision process where previously greater delegated authority had been necessary to keep things going.

And now in the nineties, in addition to communicating ideas verbally, we can do such things as complete financial and document transactions electronically, view drawings and diagrams at a distance via facsimile, and even see people as we talk with them by phone or teleconferencing facilities.

These and other technological developments represent truly dramatic shifts in the way organizations work, with the power to alter their whole rationale.

3. THE DEVELOPMENT OF ORGANIZATIONS

The benefits of harnessing individuals into an organization's integrated, coordinated force have long been recognised. Yet managing this "leverage" of individual contributions -- the science of management as we know it -- is less than 200 years old. This is even though organizations, like the "organisms" the name implies, have had to adjust as the environment has altered (due to the forces of new people, practices and pressures).

While many would argue we still have much to understand about how to make organizations effective, much *has* been learned. Very significantly, managers and owners have begun to recognise how integrating new technologies can form a key part of this process. And they realise that there are windows of opportunity -- windows which can close if a competitor moves first.

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4. KEY IT AREAS AND THEIR INFLUENCES

4.1 THE SCOPE OF INFLUENCE

Four prime reasons have been suggesed for using information technology as a strategic resource. These are:

* to gain competitive advantage;
* to improve productivity and performance;
* to open up new ways of managing and organising; and
* to develop new businesses.

In 1992 the distinctions between these are becoming less clear. Moreover, there seem to be endless possibilities for using computers and technology to achieve them-- with their success greatly influenced by management's acceptance of IT. In this paper then, rather than attempt to canvass all areas, some of the more significant are reviewed to indicate future organizational directions.

4.2 COMPETITION AND COMPETITIVE ADVANTAGE

IT can be used to increase competitive advantage and even to change the competitive environment, such as by:

* changing industry structure;

* influencing buyers and suppliers;

* creating new products and markets; and

* interpreting "process" information.

A classic example of changes to industry structure was in the printing industry not long ago, when Rupert Murdoch -- taking the idea from Eddie Shah of the newspaper *Today* -- fought the unions and won the battle for electronic typesetting. That new mode of working dramatically altered the production and distribution of newspapers -- and changed forever their labour forces and organizations.

Customer behaviour has been markedly influenced through IT -- a familiar example being the airline (and other) reservation systems. The ease and versatility of these systems encourage customers to keep returning to the same travel agents. The latter in turn tend to utilise those airlines (and hotels/motels) whose systems they have and to adjust their sales and marketing organizations accordingly.

New products and markets resulting from IT also appear constantly, necessitating new organizational approaches for their effective introduction. One of the most interesting of these -- and one, as yet, far from fully exploited -- is the "Smartcard". Its potential for handling transactions without accessing central computers is already impacting on traditional processes and functions.

Then there is the imminent influence of IT's ability to monitor, analyse and learn from "new" information . By evaluating the data constantly being generated, new approaches to managing and organizing are emerging which will change functions and relationships.

In other words, through its innovative application and its ability to gather and interpret new information, IT is changing the competitive environment and the shape of organizations in it.

4.3 DECENTRALISATION AND GLOBAL DEVELOPMENTS

One of the strongest messages from the 1991 Telecom Forum in Geneva concerned the big push to globalisation. The hype of recent years is turning into reality as managements find they have not only to decentralise further but also to link with others (even competitors) to form associations in order to meet the needs of today's and tomorrow's communities and markets.

Telecommunications and computers have been both the cause and effect of this phenomenon. They offer competitors access to better, lower cost sources; and customers the freedom to shop internationally. At the same time they they provide the means for managements to establish global frameworks and operate them, even round the clock.

As mentioned earlier, this all began with the telephone. But nowadays organizational flexibility and freedom are also shaped by by radio and satellite services as well as computers, modems and facsimile machines. Office complexes have become the organizational nerve centres and, at the same time, technology has extended the geographic reach of

individuals and firms -- enabling production and service activities to be handled at great distances from each other and from the centre, nationally and internationally.

One very significant outcome of these developments has been the emergence of the truly international organization. There is no longer a need for an enterprise always to be headquartered in its country of origin. Just as there now are widescale international arrangements for taxation and for the most economic sourcing of materials and labour, there are now grounds for locating the "head office" where communications services, reliability and tariffs dictate. In effect a very different form of corporate structure has been created by telecommunications and computers.

4.4 ORGANIZATIONAL RESOURCES

Much of IT's *publicised* contribution to manpower in organizations has been to reduce both workload and numbers, hence cutting costs and increasing cost effectiveness. And this has certainly affected business and government and their structures.

In addition, however, there are two other manpower-related roles for IT which should be included in any thinking on organizational impact.

The first of these is "telework": an arrangement whereby, through the use of telecommunications and terminals, people are able to participate in an organization's activities at a distance.

Telework permits the creative worker -- e.g. software developers, writers, designers and programmers -- to work in remote environments which can stimulate their talents. This encourages better output and saves the managerial and financial stresses of accommodating these people.

Another benefit to the organization has been that telework makes temporary labour readily accessible. Such access to resources as and when needed is not only effective but keeps the permanent organization pared down to its best fighting weight.

Thirdly, telework allows organizations to retain key skills by stimulating their interest and offering greater job flexibility, and to access others who might not otherwise be available. Centres established at a distance fom the main office can save people their valuable commuting time -- requiring more decentralised management but at the same time retaining valuable staff who might otherwise go elsewhere. Very importantly, telework provides the means for managements, if they have the ability and systems to handle it, to access staff from anywhere in the world at whatever time of day or year. Managements are already applying this concept to handle offshore data processing and program development. But it has far greater potential, with great organizational implications.

The second IT manpower-related role to mention is that of "expert systems" (or, as some prefer, "knowledge-based systems" and part of the Artificial Intelligence family). These are computer programs designed to contain the in-built knowledge of experienced people, the "experts", for access by others via terminals -- and via telecommunications links where remote access is needed).

While expert systems are still largely at the experimental stage and a long way from being in wide usage, they already indicate where organizations are headed. Their promise is that they will allow complex tasks to be handled by less experienced staff -- thereby effectively reducing the skill requirements for many roles.

4.5 COMMUNICATIONS

Organizations used to require that their people could be actually seen whenever needed. Obviously moves to decentralise and internationalise have meant a radical rethinking of that requirement. Nevertheless there are still cultures where "seeing" the person is important; and in these environments the recent introduction of reasonably priced videophones and videoconferencing facilities is beginning to increase management's "comfort" -- and accordingly raise their interest in decentralised and international activity and structure.

Satellites are also changing how executives manage distant activities. VSATs (small satellite terminals) now make contact with remote centres where telecommunications infrastructures are inadequate. They are also being used

to provide automatic access to distant data. Moreover satellite photography is offering the means of assessing the resource potential of remote regions; and the latest satellite geolocational services are opening up totally new approaches for the precise control of physical distribution systems. These different developments represent the means for eliminating positions and even whole organizational layers.

4.6 CHANGES IN MANUFACTURING

While office systems often seem to get the most publicity, the results have been arguably at least as great in manufacturing where the machine tool has been elevated, via IT, to a highly precise, programmable device.

This move has changed forever the economics of the production unit and its owner. It has made it possible to move into "flexible manufacturing" with completely different cost and operational structures. Short runs have become economic to handle, with costly and time consuming set-up times being cut dramatically. One person can now supervise sizeable batches of machines. Importantly, functions like design and production can be far apart -- even in different countries -- being linked via telecommunications.

These changes have meant significant alterations to past practice; and the world is finding that organizations now need people with very different perspectives who are able to handle the demands of increased precision, detail and integration. Experience in America in adopting new IT approaches led to the observation that traditional management attitudes, involving top-down decision making, piecemeal changes, and a "bottom-line" mentality, are incompatible with the requirements and unique capabilities of advanced manufacturing systems.

So these new technologies are also tending to bring about changes in organizational culture and behaviour as well as in structure.

5. EXPERTS' VIEWS OF TOMORROW'S ORGANIZATION

5.1 FORECASTS FOR THE 80S

Back in 1958, Harold J.Leavitt and Thomas L.Whisler predicted what organisations would be like 30 years later, largely as a result of IT.

Their view was that:

* middle management would be thinned down and given responsibilities that were more completely defined and lower paid;
* top managements would concentrate more on innovation and strategic direction and less on day-to-day; and
* there would be a tendency for large organizations to recentralise.

As the end of the eighties approached, these patterns began to appear. Now into the nineties we are seeing strong pressure for leaner, better focused organizations (with some moves to recentralisation, although as yet with a lesser emphasis than they forecast).

5.2 LOOKING TO THE FUTURE

The ever growing power and financial attractiveness of IT certainly seem to offer the possibilities for new types of organization and structure.

Some analysts expect that automated information and communication networks will support information sharing through large, widely dispersed, complex companies, making them as tightly connected as the small ones.

This suggests that large entities, whether governmental or private, will have the potential to be as flexible as small operations -- with all the analytical tools, databases and international affiliations to handle their needs. This may be so. But experience indicates that they will also need to take other action to succeed, including particularly dispensing with functions which are unnecessary or uneconomic.

It seems, most significantly, that we are moving into a time where managements truly will need to manage as never before. Technology of itself will not guarantee competitiveness. In fact with its trends are towards increased specialisation, managers will suddenly have to be better coordinators and motivators rather than industry "experts". Also, to be sufficiently forward thinking to be competitive, they will need to realise that the future lies in learning to use this technology to process "information" and not just "data".

Most people's emphasis has been on using IT to do faster what one did before. But when moves from data to information are made, there emerge totally different approaches to delegation and organizational form.

This is primarily because most organizational layers neither make decisions nor lead. They simply "process" data -- something which computers and telecommunications facilities are ideally suited to do with minimal human intervention.

The logical consequence for the information-based organization is a flatter structure -- one more closely resembling that of a century ago than today's. But to make this work will require, as Peter Drucker observes: "greater self-discipline and even greater emphasis on individual responsibility for relationships and communications".

So organizations pursuing this course will have many differences from those of today; and certainly from the 1950s model which used to be the reference.

6. WHAT DOES THIS ALL MEAN FOR THE ORGANIZATION -- AND YOU?

6.1 THE CHANGING HIERARCHIES

From their military beginnings, organizational structures have been founded on hierarchies, with tiered levels of authority from top down.

Often such hierarchies are criticised for bureaucratic slowness and stifling of initiative. However, research has found that they actually represent a very sound structure basis to release energy and creativity, rationalize performance and improve morale. Also it seems that the structure levels are related to role complexity. With IT enabling the management of greater complexity, the result is a need for fewer levels.

6.2 THE NEW DIRECTIONS

But what does all this imply for the organization and for us?

First, telecommunications and computers will mean completely new and totally different types of ventures. The opportunities are there for any of us with vision to start innovative "information" oriented activities, like SWIFT, the banking transactions marvel -- now very familiar, but quite revolutionary on first appearance. Those with the right entrepreneurial talents should benefit wonderfully from this technology.

Secondly information technology will lead to cuts in organizational positions or strata. Organizations will be flatter, with clear and more specialised job descriptions and using telecommunications for the critical management links. In turn, those who anticipate this development will be best placed to influence the shape and direction of their own areas.

Next telecommunications and computers will enable organizations to benefit from, and adjust their structures towards, internal network utilization -- where the inputs from selected people can be encouraged to stimulate improved performance. Those familiar with the processes will become network members, in a position to influence their organizations and managements.

Then there will be greater recognition of the "psychological" gains from tele-linked people, when organizations open up their communications and structure to a very different tele-worked form of inter-connection. That may be a distant horizon for the more conservative organization. However it is distinctly and imminently available to those who trust, and build trust in, their people and who listen to others' views. This may, in fact, be the most exciting and rewarding of all the IT futures -- justifying participation by those of you who have the interest and drive to win support.

7. CONCLUSIONS

Telecommunications and computers will play a pivotal role in all these developments. However, like the new applications which will emerge, the new organizations will depend finally on the people who design and run them.

The opportunities now are clearly very exciting. The final outcomes, whether in academia, business or government, will reflect some or all of the directions outlined here. But very significantly they will also, as never before, be open to influence by you, the participants.

Learning in the Imagination Age: The Student as Network Citizen

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Abstract

Technology has the capability to greatly enhance the quality of classroom learning, with its power to reach out around the world and connect students with mentors, information services, and other learners. The Education Technology Centre of British Columbia is currently prototyping an information services network for schools designed to make British Columbia students true "network citizens".

INFORMATION TECHNOLOGY AND SCHOOL RESTRUCTURING

A 1989 Royal Commission report on education in the province of British Columbia, Canada, and a subsequent review of the education system by the Ministry of Education, produced a policy framework for the future outlined in three key documents: *Policy Directions, Mandate for the School System, Year 2000: A Framework for Learning*..

The central tenets of B.C. education reform, with regard to teaching and learning, and as outlined in the *Year 2000* documents are to:

- refocus the system to meet the individual learning needs of students through personalized, self-paced learning activities, and ensure the development of skills needed for productive life in the Information Age; and to
- facilitate a change in the teacher's role from information provider to learning mentor, and in the student's role from information receiver to knowledge builder.

Current efforts at school reform and restructuring of education aim towards changing what the education system does, not simply improving what it is already doing. While many important individual reforms are aimed towards changing what happens in classrooms, the more general thrust is towards restructuring the overall educational system to make it more functional for and responsive to needs of lifelong learners in the Information Age. The strategic importance of an educational data network in implementing *Year 2000* goals and objectives cannot be over-emphasized.

Establishing new education information networks for the school system, and the home, will lead to changes in the nature of schooling, and the roles of teachers, learners and administrators. Used wisely, the new information technologies can be used to support active learning, rather than passive reception of information by learners, and they can be used to support cooperative learning. These key principles are found in the B.C. government's *Policy Directions* and *Year 2000*.

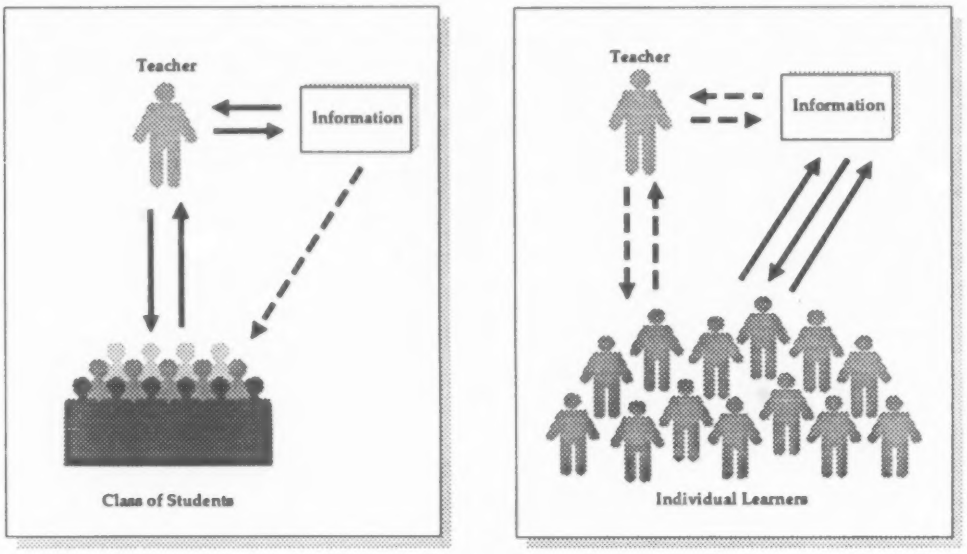

Figure 1
CHANGING PARADIGMS: FROM INFORMATION RECEIVER TO KNOWLEDGE BUILDER

THE BRITISH COLUMBIA EXPERIENCE

In May 1990, The Education Technology Centre of B.C., in cooperation with 11 school districts in the Southern Interior of British Columbia formed a consortium to prototype an information services networked designed to meet *Year 2000* education principles. Along with corporate partners, Digital Equipment Corporation of Canada, the B.C. Tel Group, B.C. Systems Corporation, the Ministry of Education and the Faculty of Education at Simon Fraser University, ETC launched the Southern Interior Telecommunications Project (SITP).

Based on recent experience with the Southern Interior Telecommunications Project, learning networks promote active student participation in the learning process, and support cooperative learning strategies involving small and large learning groups. Students in the pilot have access to a wide array of information services and databases providing up-to-date learning resources for use in the development of student

knowledge in Social Studies, Science and other areas of the curriculum. In carrying out their learning, students develop skills in navigating through large databases, evaluating which bodies of information are useful and those that are not, and in linking data drawn from diverse databases – skills that are beginning to define a new kind of literacy.

Learning involves the "construction" of knowledge. That is, learners must give meaning to new information and experiences by incorporating them into their personal frameworks for understanding the world. Research shows clearly that learning requires the active participation of the learner, and that learners must be given opportunities to reflect upon their learning experiences in order for successful learning to take place. An integral part of this reflection process is sharing one's ideas and comparing them with the ideas of others. We also know that individuals learn at different rates, and have different preferred learning styles. Learning materials and teaching approaches must therefore allow for different pacing and must make it possible for learners to explore information in a variety of ways and in a variety of individual and group settings. An education information network supports both individualized learning and collaboration among students and educators.

The role of the teacher changes in schools where information is easy to access. Teachers in these schools do not see themselves as being primarily responsible for packaging and delivering information to students, which is then tested at a later date. Rather, they view themselves as mentors who are responsible for supporting students in the development of independent learning skills, skills that are required to access, synthesize, and evaluate large, and often conflicting, bodies of information. These changes reflect many of the underlying goals of the *Year 2000* document.

In summary:

- Technology has the potential to transform the relationships between teachers and students and even to change what schools look like. The notion of network citizenship for students, teachers and school administrators is realizable.

- Students will be required to work collaboratively on projects, as well as alone. Telecommunications will be an enabling technology, allowing students not only to work collaboratively, but independent of time and space.

- Information literacy will be emphasized; that is, students must be able to locate, retrieve, synthesize and interpret information.

NETWORK CITIZENSHIP

In order that students, teachers and administrators are able to access and exchange information they must become network citizens. Fundamental to the notion of network citizenship is the recognition that information resources should be kept as close to the users as is possible. This means that information can be stored at the

workstation, school, district, regional, provincial, national or international level (via the Internet), as appropriate.

The Student as Network Citizen graphically illustrates this concept. (Figure 2)

The Network Citizenship model is the metaphor for the emerging information services network which is being designed for British Columbia schools.

As such the model drives:

- network design,
- information providers, and
- interface providers

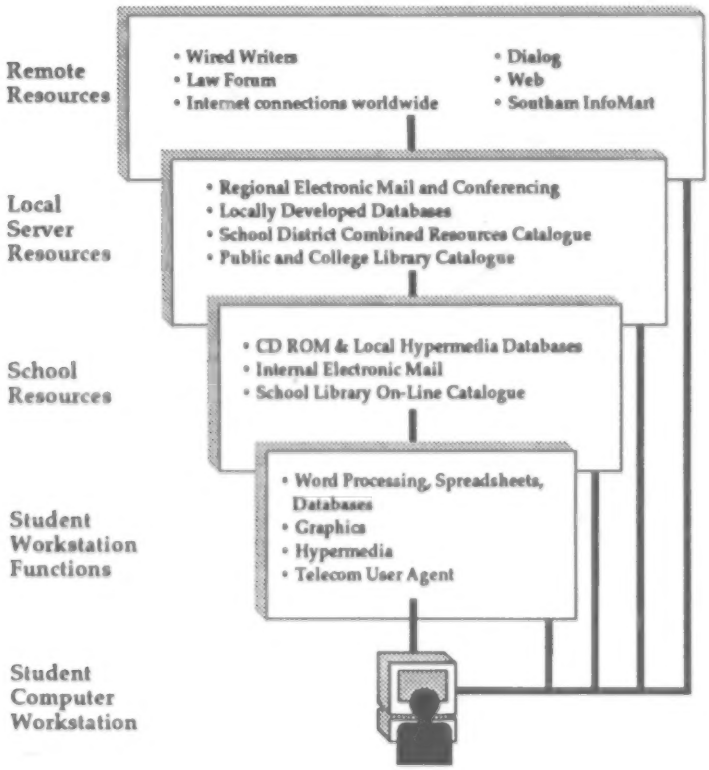

Figure 2
THE STUDENT AS NETWORK CITIZEN

A THREE-TIER NETWORK DESIGN

To connect all 75 school district offices and 1900 schools into a single, homogeneous provincial network, a three-tiered network structure is proposed as described below.

A backbone network, roughly equivalent to a network node in each school district office is envisioned.

Individual districts will then create their own district level networks according to individual needs, but subject to overriding provincial standards.

Local Area Network (LANs) at the individual school (or district) level will be connected to District Wide Area Networks (WANs). Once again, in order to connect to a district and/or provincial WAN, local LANs must comply with provincial standards, defined later in this document.

NON-INSTRUCTIONAL FACTORS AFFECTING THE TELECOMMUNICATIONS REQUIREMENTS OF THE BRITISH COLUMBIA EDUCATION SYSTEM

The previous sections of this paper have focussed on the educational rationale, needs, applications, development and support requirements of communication and information services. This final section will discuss many of the unique factors affecting the planning and strategies related to the development of a provincial education telecom-munications network for British Columbia.

There are many factors which affect the awareness, demand, and support for a provincial education network. These factors in turn affect the design, development, and implementation strategies for such a network. Many of these factors are atypical of situations in business and industry, and an appreciation of these factors is essential in understanding the provincial directions and plans in this domain. These factors are described below.

- Geography & Demography

B.C. is geographically immense and sparsely populated. The large majority of the province is mountainous, making access difficult. A large percentage of the population is based in the southwest region of the province, with the remainder distributed among a large number of small, dispersed communities. The location of these population centers could be best described as analogous to a star-topology highway system.

B.C. covers 950,000 square kilometers, roughly 2.5 times the size of Japan. However, the population is only 3 million, compared to 125 million in Japan. In addition, over 70 percent of the population is concentrated in a region representing 3 percent of the province's area. All of these factors present challenges in the development of a cost-effective telecommunications infrastructure In addition, the heavy concentration in a small region creates challenges in ensuring equity of access to all forms of resources, especially electronic information services.

- Education system organization

B.C.'s education system includes a central Ministry of Education, responsible for funding, policy, and curriculum development. The province includes 75 locally-operated school districts, with responsibility for local education program delivery and operations, each governed by

a locally-elected Board of School Trustees. This organization creates perpetual struggles over centralized versus decentralized control of programs and financial resources. Thus, the consensus-building process related to the need for an enterprise-wide network for the education system is affected by issues of mutual trust and autonomy. No single body is individually capable of providing the financial and human resources necessary to commit to the implementation of such a network.

These student population range of the 75 school districts ranges from 700 to 55,000 students, with a total of 530,000 students attending 1600 schools in the public education system (average school size of 330 students). An additional 35,000 students attend one of 300 autonomous independent schools (average school size of 100 students). Thus, a wide range of organizational and management structures exists in the B.C. school system. Thus, a common suite of communication and information services is considered of less value than might be expected.

- Educational information technology usage

The use of microcomputers and related information technology in B.C. schools has been a grass roots movement, with most acquisition and utilization decisions being ad hoc, locally idiosyncratic, and virtually devoid of large-scale formal consideration of standards. Fortunately, B.C. has been blessed with a large group of committed, innovative educators who have frequently been leaders in setting global directions related to education applications of technology. This grass roots movement has resulted in a significant installed base of microcomputers in classrooms, libraries, and laboratories. Recent surveys estimate approximately 46,000 computers servicing 565,000 students and 38,000 educators, yielding a student-to-computer ratio of approximately 12 to 1. However, an enormous range of priorities and access policies exist in individual schools, resulting in little province-wide consistency in how information technology is used to support the educational activities of the system.

Several de facto standards for workstations and LANs have developed, and the Ministry of Education has recently identified a set of common standards which reflect the extant situation. However, given the cost-sensitive, time-dependent nature of capital expenditures in public education, it is estimated that only a third of the existing technology is likely to meet emerging workstation and networkability standards, resulting in a large group of "legacy systems", most of which are non-expandable, stand-alone workstations. This technology must be recognized in the planning process, but is likely to be of only modest transitional value in the network implementation process.

Those school-based workstations which are likely to meet networkability standards include an approximately equivalent number of Macintosh and Windows-capable MS-DOS machines. Common LANs include AppleShare and MacJanet (running over AppleTalk and EtherTalk), and Novell NetWare (running over Token Ring and ArcNet).

- Extant government and education system communication networks

The vast majority of B.C. provincial government information processing and networking services are provided by the

B.C. Systems Corporation (BCSC), a semi-autonomous Crown Corporation. The distributed nature of B.C. government operations has resulted in a network which reaches a surprisingly large number of moderately-sized communities, albeit with relatively low bandwidth best capable of supporting text and data applications.. Current planning for a provincial education network is concentrating on the viability of the existing BCSC network as a provincial backbone carrier.

Education is the only industry in which most professionals do not have easy access to voice and data communications. Few schools have extensive phone systems reaching beyond a small number of locals, and even fewer have access to dialup or dedicated data services. The cost and breadth of access to regulated public packet-switched networks has negatively impacted this situation.

- Education's cost-sensitive approach to service provision

Public education has been, and will continue to be very cost-sensitive, and generally incapable of supporting unpredictable, usage-sensitive costs. Thus, it is essential that predictable, flat-rated network development and operations, as well as services, be considered wherever practical. Public domain software should receive strong consideration. Large-scale licensing of a suite of information services will likely need to be negotiated. Client-server models for e-mail, conference participation and database / information service search & retrieval are critical, since they minimize on-line, usage-sensitive costs, and make these more predictable on a large scale. Client-server applications also minimize network loads, increasing the utility of relatively low-bandwidth network services.

- Education system experience, training, and support requirements

While a strong cadre of experienced, technology-supportive educators exist in the B.C. system, the majority of educators have limited experience with technology, usually within a narrow range of applications. Most educators would be considered technology-neutral or technology-apprehensive. Currently, only a modest minority of educators believe that technology can and should play a mission-critical role in supporting the educational reform process. Most currently consider technology to be "add-on" rather than integrative. Finally, most educators are sporadic users of technology, thus lacking the regular usage patterns that develop generalizable skills and the problem-solving experimental approach necessary for successful use of a range of software applications.

This educator experience situation results in a desire for stable, consistent operating environments. Unfortunately, telecommunication-based services are generally immature technologies, with evolving standards, products, and network access protocols. It is not surprising that many educators consider these services to be "bleeding edge", fraught with startup and support frustrations that are more difficult to resolve in a distributed set of autonomous school districts than would be the case in most business and industry environments.

Educators have limited access to and financial support for technology-related professional training programs. The breadth of experience, technologies, and applications make broad-scale training difficult to offer and generally less-than-effective. Rarely, if ever, is technology training mandated. The most effective technology training in

education is self-directed by individuals who are able to analyze their training requirements and to build a personal program to fulfill those needs. Thus, most effective training is needs-driven, on-the-job, intrinsically-motivated, and individualized.

This experience and training situation accentuates the need for intuitive, self-documented, customizable, graphical user interfaces (GUIs), consistently implemented to support a variety of applications. While these applications exist in many application domains, they are only now becoming more widely available for telecommunication-based services

- Standards??

In general, the education system employs very few information systems professionals. Similarly, IS consultants are not commonly contracted to analyze and recommend solutions for educational environments. This results in a situation where much of the decision-making authority lies in the hands of senior school district management who do not have the necessary support to make informed decisions related to strategic planning for critical technologies, including local and wide-area networks. This, in turn, provides opportunities for hardware and software vendors to offer attractive products which may provide short-term solutions, but which may not support long-term goals and directions.

This problem is especially evident in the telecommunications and networking domains. Little recognition or understanding of standards exists in school systems, and this is a significant impediment to building commitment towards a long-term, enterprise-wide networking strategy. Most education decision-makers fail to recognize the critical nature of an "open systems" approach to standards definition, product and service selection. This also makes it difficult for education systems to develop transitional strategies that recognize industry-leading de facto standards. Given the complex nature of a standards-based strategy, there is some question whether the B.C. education system (and likely most others) are currently able to understand and support this approach.

CONCLUSION

The potential for telecommunications-based services in education is only now being realized. Many exciting applications are being developed and validated. However, the public education system faces many challenges related to clear, consensus education rationales, effective support and training, education-specific applications development, organization and management structures. It is expected that potential solutions to these challenges will be developed and evaluated over the next few years to ensure that the education system has some control over its destiny in the quest to develop mission-critical, enterprise-wide communications and information networks.

ISDN APPLICATIONS...?
IT DEPENDS...!!!

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1. ABSTRACT

Unless vendors and end users step up to some "agreements" being formulated, ISDN will do considerably less than it could otherwise. The value of ISDN applications will be perceived differently by various companies. However, it is a fact that some companies are installing ISDN today and reaping benefits based on their individual needs. The purpose of this paper is to examine what normal steps this technology will have to follow for broad acceptance, which steps is it already in the middle of, and, most importantly, what critical steps remain for the marketplace "pull" to take over the vendor "push" of today.

The first step for our analysis is the native search for applications, which any new technology will have to conduct. Applications, in the ISDN world, are spelled S-O-F-T-W-A-R-E, which will be the life-blood to this technology. Software lives in three major locations today: 1), in the IEC or LEC switch which is connected via the Primary Rate Interface to the client's large CPE; 2), in the LEC or PBX switch which provides services to the client's desktop; and, 3), in the PBX, on the trunk side, providing networking features between PBXs. Today the three driving applications, which by themselves cost-justify the technology decisions, are: 1), Telemarketing Group Enhancements; 2), Analog Key System Replacement; and, 3), Enhanced PBX Networking. The three software locations and applications listings coincide, as we will see below, and have gotten varying amounts of publicity.

1) The most celebrated application is the Primary Rate Interface delivery of the calling telephone number (Automatic Number Identification, or ANI) on an 800-Service number to a telemarketing group. How much of a value this capability is to an organization can be measured by the question: What would you do if you knew what number was calling BEFORE you picked up the call? The delivery of ANI has reportedly saved telemarketing agents from 4-20 seconds per call (It Depends...). Although this seems to be a small amount of time, one company that we surveyed managed to convert these "seconds" to over 400 hours of 800-Service billed time saved. But that's only part of the equation for the telemarketing manager.

Besides saving agent time and salary, the telemarketing world now has a second question to measure ANI's value: What would you do if the Average Call Holding Time was decreased? When reviewing the issues of Agent Billed Time, Number of Calls Handled, and Level of Customer Service we see once again the answer is very individual (It Depends...). Some clients will want to reduce agent expenses (not numbers of agents, though), while others will want to increase the number of calls Handled, while still others will want to keep the number of agents and calls constant but differentiate their operations by providing higher levels of customer service. As subjective as these issues are, clients are installing ISDN for real benefits to their bottom line - today.

2) The Basic Interface's most celebrated application is Analog Key System Replacement. Many clients today that own an analog system are looking at ways to improve services at the user's desktop. In the past, services were invoked with a combination of Touch-Tone signals and switchhook flashes (hopefully done at the right time for the correct amount of time). Many of us have seen telephone sets with the faceplate that describes how to invoke a service with the "*" plus a number code, while the cancellation of the service (or invoking another service) might be brought about with the "#" plus the same number code. Pre-ISDN clients that wanted higher feature/functionality had few options outside of purchasing a PBX with a proprietary signaling protocol. This, of course, required the client to purchase subsequent higher feature/functionality CPE from the original vendor. The Basic Interface recommendations (followed by the emerging National ISDN-1 specifications) now allow clients a choice.

Clients that have Basic Interface service from a Telephone Company Central Office have approximately a dozen different vendors from whom they may purchase CPE. The most flexible of these are the Personal Computer Terminal Adapters (PCTAs).

Using software to load both the standardized signaling messages and the vendor-specific extensions of the protocol, PCTAs can support high feature/functionality enhancements to analog telephone service at the desktop. Software in the PCs can emulate more expensive telephone sets and features can be invoked using the keyboard of the computer.

3) The third driving application is loading ISDN networking software on the PBX at a client's location and connecting it either to a second PBX via a private facility, or to a Private Virtual Network using a leased- or switched-facility. In the beginning days of this application the benefits appear to be small, if any. This software does NOT usually provide enhancements to proprietary networking capabilities that exist between PBXs made by the same manufacturer. It does, however, provide a platform for interworking between different manufacturers' PBXs.

Work on standards for communicating between different manufacturers' PBXs has been painstakingly slow. However, the Q.931 signaling messages, and vendor-specific extensions, can be loaded onto an IEC or LEC toll/tandem switch which can act both as a switch and an interpreter. Inter-switch services utilizing the standard signaling messages will be switched normally while the vendor-specific extensions can be translated or "mapped" from the originating vendor's coding to the terminating vendor's coding. The set of services that are supported today are VERY small, but the more important direction of inter-vendor interoperability gives us hope for future enhancements.

Other applications in the ISDN world that are less aggressively sought-out include several voice-only and voice/data capabilities. Data-only applications are not as abundant, but this is probably due to a wide range of open, pre-ISDN protocols that were already integrated into the market.

The second step of our analysis is what steps has ISDN already taken, and how does this infrastructure help it to grow? In networking, this infrastructure is spelled Signaling System Number 7 (SS7) and its job is to take us out of "Island ISDN" and into "Ubiquitious ISDN". The SS7 protocol is implemented between the network switches and the Signal Transfer Points which quickly relays the messages to the next switch. Not only does SS7 enable faster call setup, but the ISDN User Part (ISUP) carries a mapping of the Q.931 Signaling Message Information Elements that allow services to be passed between ISDN-capable switches. However, to implement this capability nation-wide, there is a considerable investment that has to occur in software, network facilities, and hardware.

The biggest investment in hardware that has to be installed by all the LECs is the Signal Transfer Point. These fully redundant, high-speed, high-reliable (most of the time), high-dollar machines are sold in mated pairs and installed in different parts of the service area (so that catastrophic disasters do not take down the whole signaling network).

Network facilities have been specified as running 4800 bps (analog) up to 56/64 Kbps (DDS or DSO in a DS1). These links (lettered A-link through F-link depending on what they connect) are usually duplicated so that there are two links between any two pieces of network equipment. These links are both active (one SS7 myth is that they are active/standby) and load share traffic between network "signaling points", however ALL the messages for a single call are carried on the same links for the life of the call.

Software "packages" are installed depending upon the services offered by the network. The two main packages that we need to carry our ISDN signaling messages are Message Transfer Part (which finds the path through the network) and ISDN User Part (which carries the mapping of the Q.931 signaling message).

The next major issue is how we will pass SS7 capabilities between the IECs and the LECs. This capability, named Network Interconnect, is a very hot subject among users and providers today. The main technical issue is how do we pass needed information from one carrier to another (ANI), and keep proprietary information (billing records, network configurations, etc.) guarded. Certain "firewalls" needed to be constructed for the allowances/protections and most of the technical work beyond that has either been decided or is well under way. Business issues, though, will still have to be worked out.

The biggest business issue in the public eye right now is revenue sharing for delivery of ANI. If the customer is billed one or two cents per delivery of ANI who gets how much of that revenue? The IEC will claim that they are entitled to it due to the Feature Group D tariffs that they pay. The LECs will want their "fair share" for the ANI origination or delivery. Where ideas

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for solutions are all over the board, one of the most interesting to this author is the idea that the IEC "gives away"

ANI to the LEC in hopes of stimulating more calling over the network (similar to the marketing idea of giving away razors to help sell razor blades).

However the issues are resolved, the infrastructure of SS7 and Network Interconnect is needed to passing out-of-band signaling messages and supporting high-speed data connectivity - both vital to the success of inter-switch ISDN.

The last step of our analysis is to identify the future changes that have to occur to move ISDN from a "vendor-push technology" to a "market-driven success". For any technology to successfully make this transition the vendors have to answer the implicit (or explicit) question from the marketplace: "Hey, what's in it for me to buy this...?" Just as the Personal Computer industry found their lifeblood in application software, ISDN must be driven by the same kinds of creative minds that put technology to use in the layperson's world. However, to accomplish this we need to have the same capability that PC applications depend upon for successful software development: a standard interface.

Personal Computers have had a limited set of operating systems and backplane interfaces over the years. Arguably, the most popular combination has been the PC/XT/AT hardware and DOS software. Because these were published interfaces many different vendors could build hardware peripherals or write software packages to be sold with these computers. Some of the benefits to the end user included feature competition, multi-vendor interoperability, increased cost/benefit ratios and more. There already exists standard hardware interfaces defined for ISDN. What ISDN needs more are some standard interfaces to the world of software.

The three architectures that this software would support are: 1), PBX-to-Host Computer; 2), Desktop/PC-to-Central Office; and, 3), Host Computer-to-Central Office. Because the first architecture is fairly well understood by a large population of PBX and Host Computer vendors and the third architecture does not appear to have a large group of devotees, we will focus the remainder of the discussion on the second architecture. This is where similarities between the spreadsheet software, which was needed to justify my Personal Computer, can be seen with the need for software to justify my ISDN decisions.

Software for ISDN today has to be written to an applications programing interface (API) for the Personal Computer Terminal Adapter (PCTA). Today this API is vendor-specific, which has some advantages but carries for the user some potentially frustrating consequences. The main advantages for a vendor-specific interface is the constant "cost/feature-wars" as each vendor shows why you should purchase their PCTA. The problem is that if you purchase software that is written for just one PCTA's API you are left stranded if the vendor goes out-of-business, can't afford to invest in additional applications, or doesn't think your particular application warrants the investment. To avoid these unfavorable situations, we need a standard way that an application can talk to any PCTA - we need a standard API for our ISDN applications.

The group that is advancing this process is the Applications Software Interface group which is sponsored by North American ISDN Users Forum (NIU). Cheng Chen of Teleos Corporation is the Chairman for this group which has just this past October received approval of the API they have been working on. The "vendor's agreement" (they aren't chartered as a standards group) for the API supports a small set of subroutine calls for DOS-based architectures. Unix and OS/2 work is due to be completed by the end of 1992 which will further increase the benefit of this API. There have even been meetings to see how the work being done by the NIU group might be "harmonized" with European versions of this capability. Yet, there is still work that vendors and end users need to do here in the North American marketplace - support, fully, the work done by the ASI committee.

One of the biggest threats to the "standardized" API is lack of support from PCTA vendors. The fear is that they will provide SOME support, but that they will continue to promote their proprietary solution. It would only make good marketing sense to "support" this API but encourage vendors to build to the "richer vendor-specific API for more capabilities...". This "damning with faint praise..." could leave the market place with the same liabilities as not having one at all. Therefore for ISDN applications successes to extend industry-wide we need both vendor- AND USER support for this interface.

Support in free enterprise means that

you purchase the products that will help you (both in the long- and short-term). This also means that you don't purchase products that will hinder the growth of this capability. If your vendor of PCTAs doesn't support (read: implement!) the ASI API tell them that you think that it's important for your software investment and business applications. If they do support it (i.e.: Teleos and Link Technologies), tell your software vendor that you'd like to use their products and ISDN service and that you're buying software from vendors that support the ASI API. Unless we implement these methods of "support" for the API, we may see a very stagnant software development effort for ISDN. And without the software to pull-through sales, ISDN could take much longer to serve end-users with the applications that only a truly integrated interface can provide.

2500 Sets (aka POTS sets): Single-line, analog telephones

ANI: See Automatic Number Identification

Automatic Number Identification (aka: ANI, Calling Line Identification, CLID, Incoming Calling Line Identification, ICLID): Delivery of the CALLING telephone number to the subscriber at the CALLED end. Differs from Station Identification (or, Customer Station Identification) because ANI is the number that is BILLED and may not indicate the extension number of the telephone.

Basic Interface (aka: Basic Rate Interface, BRI, Basic Rate Access, BRA): Two (2) Full-Duplex, Circuit-Switched "Bearer" Channels at 64Kbs each, plus one "Delta" Channel at 16Kbs for Q.931 Signaling Messages and X.25 User Data Packets.

Basic Rate Access: See Basic Interface

Basic Rate Interface: See Basic Interface

Bearer Channel: A 64Kbs Full-Duplex Circuit-Switched Channel which can be used for voice, circuit-switched data, or "nailed-up" to a packet device to carry higher-speed (56- or 64Kbs) user data packets

BRA: See Basic Interface

BRI: See Basic Interface

CLID: See Automatic Number Identification

Calling Line Identification: See Automatic Number Identification

CPE: See Customer Provided Equipment

CSI: See Station Identification

Customer Provided Equipment (aka: CPE): Customer-owned telecommunications equipment (i.e.: telephone sets, fax machines, PBXs, etc.)

Customer Station Identification: See Station Identification

D-Channel: See Delta Channel

Data Channel: See Delta Channel

Delta Channel (aka: D-Channel, Data Channel): The signaling channel used for setting up and controlling Bearer Channels. On the Basic Interface it is defined as 16Kbs and can carry both the Q.931 Signaling Messages AND X.25 user data packets. On the Primary Rate Interface it is defined as 64Kbs and carries Q.931 signaling messages ONLY.

ICLID: See Automatic Number Identification

IEC: See Interexchange Carrier

Incoming Calling Line Identification: See Automatic Number Identification

Interexchange Carrier (aka: IEC, IXC): Companies allowed to carry traffic across LATA boundaries (i.e.: AT&T, MCI, US Sprint).

IXC: See Interexchange Carrier

LATA: See Local Access Transport Area

LEC: See Local Exchange Company

Local Access Transport Area (aka: LATA): A geographical area which roughly conforms to a local calling area. LECs are allowed to carry traffic within LATA boundaries, but are required to send inter-LATA traffic to an Interexchange Carrier.

Local Exchange Companies (aka: LECs): The telephone company for a particular area.

NFAS: See Non Facility-Associated Signaling

Non Facility-Associated Signaling: In ISDN, a method of signaling which allows an active D-channel in one Primary Rate Interface to set-up and control calls in a separate Primary Rate Interface.

PABX: See Private Branch Exchange

PBX: See Private Branch Exchange

Plain Old Telephone Service (aka: POTS): Traditional analog telephone service using rotary-dial or Touch-Tone phones.

POTS: See Plain Old Telephone Service

PRA: See Primary Rate Interface

PRI: See Primary Rate Interface

Primary Rate Interface: Twenty-three (23) Full-Duplex, Circuit-Switched "Bearer" Channels at 64Kbs, plus one "Delta" Channel at 64Kbs for Q.931 Signaling Messages (alternative configuration with Non Facility-Associated Signaling is twenty-four "Bearer" Channels).

SID: See Station Identification

Station Identification (aka: SID, Customer Station Identification, CSI): A customer-provided outpulsing of the calling station's identification (usually the extension number). Differs from the delivery of the BILLING number (Automatic Number Identification) in that not every communications system sends SID and not every network delivers SID.

An Advanced Satellite Communication System for ISDN Subscriber and Trunk Applications

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1. ABSTRACT

This paper describes an advanced satellite communication system for ISDN subscriber and trunk applications. NTT has developed a new satellite communication system, DYANET-II (DYnamic channel Assigning and routing satellite aided digital NETwork-II) integrated into a terrestrial ISDN, by extending the system concept of DYANET. To apply satellite communications to the ISDN subscriber portion, in addition to the trunk portion, new network control technologies have been developed to achieve efficient satellite channel utilization and a single hop connection in DYANET-II. Moreover, compact earth station equipment has been developed for customer premise use.

2. INTRODUCTION

Satellite communications have unique features that terrestrial systems do not have. These include multiple access capability, wide coverage of service areas, and rapid and flexible network re-arrangement. From the viewpoint of traffic concentration, satellite communications can gather light traffic scattered over a wide area and carry it through common satellite channels.

NTT has recently developed a novel satellite communication system called "DYnamic channel Assigning and routing satellite aided digital NETwork (DYANET)" which takes advantage of the above-mentioned features of satellite communications. DYANET is used in combination with terrestrial networks, and it carries overflowed traffic among transit switches through common satellite channels. The main feature of DYANET is that its function is equivalent to a single transit switch. DYANET has been in commercial use since October 1988(1) (2) (3).

NTT initiated ISDN services in April 1988(4). In the evolutional phase of ISDN services, the service area is limited because a long time is needed to establish the infrastructure of ISDN all over Japan. Therefore, A communication system is strongly required that can economically accommodate ISDN subscribers at an area far from the service access point for fast and nationwide expansion of ISDN services. Satellite communication is one of the most promising ways of doing this, because ISDN subscribers can be accommodated by installing an earth station on the customer premises. Subscriber application using satellite communications will also be useful for temporary or emergency use.

To accomplish the above-mentioned purpose, an advanced satellite communication system, DYANET-II has been newly developed for ISDN subscriber and trunk applications, by extending the system concept of DYANET. This paper describes the system concept and network configuration of DYANET-II, which are followed by an advanced network control system and a radio communication system for DYANET-II.

3. SYSTEM CONCEPT OF DYANET-II

3.1 FEATURES OF SATELLITE COMMUNICATIONS

Figure 1 shows the network structure using satellite and terrestrial communication systems from the viewpoint of traffic concentration. A communication network generally consists of many transmission sections that are classified to categories: a trunk portion and a subscriber portion. For a trunk portion in terrestrial systems, regional traffic is concentrated by exchangers and this concentrated traffic is economically carried by high-capacity transmission systems. The terrestrial communication systems are more suitable than satellite, when traffic is heavy and sufficiently concentrated within adjacent areas. On the other hand, by taking advantage of satellite communications' multiple access capability and wide service area coverage, variable and widely dispersed traffic can be easily concentrated and many sections can use common satellite circuits on a time-sharing basis. This means that satellite communication systems are more suitable than terrestrial systems for carrying light and variable traffic dispersed over a wide area.

Features of terrestrial and satellite communication systems are shown in Fig.2. This figure indicates that the most economical ISDN can be created by combining satellite systems with terrestrial systems.

3.2 APPLICATION FOR TRUNK PORTION

Let us suppose that a transit switch selects the first routing circuits and it selects the second routing circuits only when all of the first routing circuits are occupied. By applying this routing principle, trunk traffic is classified to two groups: one is heavy and constant traffic and the other is light and variable traffic.

In DYANET, the former traffic is carried by high-capacity terrestrial transmission systems such as optical fiber transmission systems, and the latter traffic is carried by demand-assignment satellite communication systems, where satellite channels are set up on a call-by-call basis between an originating transit switch and a terminating transit

switch nearest to the called party. "Farthest end routing" control, is adopted to select a terminating transit switch and an earth station connected to it.

In this way, a terrestrial transmission system is used very efficiently. The satellite channels are also efficiently used compared with pre-assigned satellite channels, since the satellite channels are used in common by many transit sections on a time sharing basis. The integration of satellite communication networks with terrestrial networks makes it possible to reduce total transit network cost by reducing the required number of trunk circuits to meet the specified blocking rate (0.01, for example).

3.3 APPLICATIONS FOR SUBSCRIBER PORTION

In the evolutional stage of ISDN services, ISDN subscriber lines are not available or not cost effective, especially in rural areas where subscriber traffic is scattered over a wide area. This situation is more real for primary rate ISDN services since a lot of time and cost are needed to establish an optical subscriber network infrastructure.

On the other hand, considering traffic characteristics on the subscriber portion, the calling rate is around 0.1 erl. per one B-channel even for business use. This is significantly low traffic compared with trunk traffic. In addition to that, this traffic is time-varying according to the usage of customers. These traffic characteristics are basically suitable to satellite communications application. Since many ISDN subscribers can share a common satellite on a demand basis, satellite communications can be useful in supplementing a terrestrial ISDN. Such a satellite communication system can accommodate five-to-ten times as many ISDN subscribers as a pre-assignment satellite communication system.

3.4 REQUIREMENTS FOR APPLICATION OF SATELLITE COMMUNICATIONS TO ISDN

Figure 3 illustrates the network configuration of ISDN in Japan, where both basic rate and primary rate user-network interfaces (UNI) are offered. Layer 1 user-network interface (UNI) for both basic and primary rates meets CCITT recommendations I.430 and I.431. The 2B+D configuration for basic rate UNI provides customers with two 64kb/s information channels and a separate 16kb/s signaling channel. On the other hand, the primary rate interface provides customers with 24x64kb/s channels, for a total capacity of 1.5Mb/s. In addition, as shown in Fig. 3, a conventional public switched telephone network (PSTN) is incorporated in ISDN, except in the subscriber portion.

There are essential requirements from the viewpoint of network services, especially for subscriber applications, when considering the satellite communication applications to a public ISDN. First, it is indispensable to provide the customers using satellite with the same ISDN services for those using terrestrial transmission, in terms of the numbering, signaling, and charging system, as well as user-network interface. This means that customers will not face subscriber number changing when they are served by a terrestrial transmission media in the future. It also means that the communication tariff does not depend on the transmission media, satellite or terrestrial. This basic system concept makes it possible to avoid a drastic modification of a terrestrial ISDN for applying satellite communications to ISDN. Moreover, it requires the utilization of satellite channels more efficiently because they are limited resources.

Taking the above-mentioned requirements into account, an advanced satellite communication system called "DYANET-II" has been developed, for both the trunk and subscriber portion, by extending the system concept of DYANET.

4 NETWORK CONFIGURATION OF DYANET-II

4.1 SYSTEM CONFIGURATION

In a terrestrial ISDN, each subscriber is connected to a designated local switch, to which an area code is assigned according to the numbering plan. To apply the same numbering, signaling, and charging system to satellite subscribers as terrestrial subscribers, an ISDN satellite subscriber is accommodated by the local switch covering the service area in the same manner as a terrestrial ISDN subscriber.

The network configuration of DYANET-II is shown in Fig. 4. DYANET-II consists of a communication satellite using Ku band, a control earth station (CES), base earth stations (BESs), user earth stations (UESs), a satellite channel control unit (SCU), and a satellite communication transit exchange unit (SXU), with local switches (LSs) and transit switches (TSs).

A UES is installed on customer premises and it offers basic and primary rate user-network interface for ISDN services. A UES is virtually connected to an LS according to the numbering plan. A BES has two sorts of terrestrial interfaces: one is a subscriber interface and the other is a trunk interface. The subscriber interface of a BES is connected to the subscriber circuits of an LS. Trunk circuits of an LS and TS can be connected to the trunk interface of a BES to carry overflowed trunk traffic as in DYANET.

4.2 FUNCTION OF DYANET-II

SXU is connected to LSs and TSs via a common channel signaling (CCS) network. SXU and LSs accommodating satellite ISDN subscribers are connected to SCU via a dedicated data communication network. An LS terminates call control signals on the subscriber portion (between an ISDN subscriber and an LS) and transmits satellite channel control signals to SCU. Regarding call control signals on the trunk portion (between SXU and an LS/TS), SXU terminates them and transmits satellite channel control signals to SCU. According to satellite channel control signals from LSs and SXU, SCU sets up and releases satellite channels, by sending satellite channel assignment signals to UESs/BESs through satellite circuits. It is noted that each LS has the similar functions to SXU in DYANET-II. Therefore, a satellite channel control software has been newly developed and implemented in each LS.

SXU carries out switching control of the trunk circuits and the LSs carry out switching control of the subscriber circuits in DYANET-II. When a call is routed to SXU, it chooses the terminating BES and a terminating LS/TS closest to the called party by "farthest end routing", to ensure a single hop connection on the trunk portion. If a called party is an ISDN satellite subscriber, a terminating LS sends SCU satellite channel control signals to change the

connection of the satellite channels. In this way, a single hop connection is ensured for any connection, such as a UES-UES or UES-BES connection.

Figure 5 shows an equivalent network model of DYANET-II. DYANET-II applies a demand-assignment TDMA (Time Division Multiple Access) scheme with carrier (transponder) hopping capability. As satellite channels are set up on a call-by-call basis by assigning a time slot on a TDMA frame and a carrier frequency to a BES/UES, the satellite system of DYANET-II comprising UESs and BESs is essentially equivalent to a dispersed switch circuit combining a subscriber portion with a trunk portion. An LS has "control functions" for satellite channels on a subscriber portion and SXU has "control functions" for satellite channels on a trunk portion. Therefore, the function of DYANET-II is essentially equivalent to a dispersed switch circuit controlled by an SXU and LSs.

4.3 ACCESS CHANNEL SPLITTING CONTROL

In a terrestrial subscriber line, all channels exist at every moment. However, such a channel on the subscriber portion is actually used only when a call occurs. Therefore, all channels do not necessarily need to exist at every moment. For efficient utilization of satellite channels, a satellite channel in actual use should be set up on a demand-assignment basis. In addition, to meet CCITT recommendation G.114 on end-to-end delay for telephone services, it is indispensable to ensure a single hop connection between any earth stations including subscriber earth stations. This implies that each satellite channel on the subscriber portion should be handled separately since it can have a different destination. For this purpose, "access channel splitting" control has been newly introduced.

The satellite access channel of DYANET-II is handled as follows:

(a) While a subscriber interface layer-1 is activated, a satellite channel for D-channel is set up between the terminal and the local switch.
(b) While a call is progress, satellite channels for the B/H-channel are set up depending on the information transfer rate of that call.
(c) Satellite connection of the B/H-channel can be changed according to the destination of the call to ensure a single hop connection.

4.4 ECHO CONTROL

The terrestrial interface of the trunk portion at a BES is illustrated in Fig.6. Echo cancellers are implemented between a BES and a TS/LS at the trunk circuit for audio/speech call. SXU and the TS/LS select the trunk circuit with/without an echo canceller according to the call type (non-restricted bearer or audio/speech call) on a call-by-call basis.

For echo control in a subscriber portion, echo cancellers are implemented in both a UES and a BES. Switching of those are controlled by an ISM according to the call type on a call-by-call basis. Figure 7 shows an example of a connection for satellite subscribers. For a UES-UES connection, echo cancellers on both UESs are enabled for audio/speech call. They are disabled for non-restricted bearer call.

4.5 SUBSCRIBER CONTROL SIGNAL TRANSMISSION

B/H- and D-channel are managed by SCU and they are set up on a call-by-call basis. On the other hand, a data channel for satellite channel control is established between SCU and each BES/UES through CES on a pre-assignment basis. In a terrestrial subscriber transmission, subscriber control signals for Layer-1 activation/inactivation control at T reference point and operation administration and maintenance, are included along with B/H- and D-channels. In DYANET-II, satellite channel control circuits are also used to transmit/receive these subscriber control signals. To utilize satellite channel control circuits efficiently, a novel technique has been developed; that is, subscriber control signals are transmitted to SCU as packet data, only when a transition of subscriber control signals occurs. SCU transfers the received data from a UES/BES to the designated BES/UES. Therefore, SCU works as a packet switch for subscriber control signal transmission.

5. NETWORK CONTROL SYSTEM FOR DYANET-II

5.1 FARTHEST END ROUTING CONTROL

Demand assignment satellite channels are established dynamically between earth stations. To avoid a multi-hop connection of a satellite channel and efficiently use satellite channels, DYANET-II adopts "farthest end routing" control, which selects a direct route to the BES farthest from the originating TS/LS; that is to the BES nearest to the terminating terrestrial subscriber or the BES, to which the terminating UES is connected. SXU determines the farthest end BES according to the destination number.

The concept of "farthest end routing" in DYANET-II is shown in Fig. 8. Suppose that a UES connected to LS-1 calls to a terrestrial terminal connected to another LS-2. SXU translates the destination number and selects the terminating BES and LS or TS nearest the terrestrial terminal (i.e. BES-4 and LS-2) from among the possible terminating BESs at TSs/LSs. It should be noted that "farthest end routing" is effective in avoiding multi-hop a connection on the trunk portion only.

5.2 CHANGE CONNECTION CONTROL

In a public switched network, an end-to-end connection is established on a link-by-link basis by each switching node. Therefore, if a satellite channel is set up on the subscriber portion (between a UES and a BES) and the called party is a satellite subscriber, change connection is indispensable in establishing a single hop connection between two UESs or a UES and another BES. To ensure a single hop connection for a UES-UES or a UES-BES connection, "change connection control" has been newly developed for DYANET-II.

Figure 9 shows an example of "change connection control" to establish a single hop connection between two UESs.

(a) Phase 1: When a satellite subscriber generates a call, a satellite channel is set up between a UES (calling subscriber) and a BES connected to the originating LS. Then, the LS sends call control signals to SXU via CCS.
(b) Phase 2: SXU carries out "farthest end routing" control and establishes the connection between the originating LS and the terminating LS via

CCS. In addition, SXU sends satellite channel control signals to SCU to change the connection. As a result, a satellite channel is established between the UES (calling subscriber) and the BES connected to the terminating LS.

(c) Phase 3: The terminating LS sends satellite channel control signals to SCU to change the connection again. Finally, the connection between the originating UES and the terminating UES (called subscriber) is established.

5.3 D-CHANNEL DEMAND ASSIGNMENT CONTROL

DYANET-II supports the same layer-1 activation/inactivation sequence for satellite subscribers. Figure 10 shows the layer-1 activation procedure for a satellite subscriber. INFO signals indicate layer-1 statuses. Layer-1 control signals, INFO 1' - INFO 4', correspond to the INFO signal defined by CCITT recommendation I.430. SCU checks all layer-1 control signals received from UESs and BESs. When SCU detects layer-1 activation such as INFO 1', it establishes a satellite channel for D-channel. Similarly, SCU releases the satellite channel by detecting layer-1 deactivation.

5.4 CALL CONTROL PROCEDURE

Figure 11 shows an example of a call control procedure when both originating and terminating subscribers are accommodated by satellite. The procedure consists of three phases as described bellow:

(A) Phase 1

(a) When the user terminal initiates a call with layer-1 activation, a satellite channel for D-channel is established. After establishment of the D-channel and layer-1 activation, the originating terminal sends SETUP to the LS.

(b) When the LS receives the SETUP message , it transmits CSR (channel setup request) to SCU. SCU sets up a satellite channel between the originating UES and the BES connected to the originating LS.

(c) When SCU confirms the establishment of a satellite channel between the UES and the BES, SCU sends a CSA (Channel Setup Ack) to the originating LS.

(d) After receiving the CSA from SCU, the LS sends CALL PROC to the originating terminal. It sends an IAM (Initial Address Message) to SXU, as well.

(B) Phase 2

(a) When SXU receives the IAM from the originating LS, SXU determines the terminating BES according to the farthest end routing and sends a CCR (Change Connection Request) to SCU.

(b)When SCU receives the CCR from SXU, SCU searches the first connection between the UES and the BES connected to the originating LS, releases it and establishes a satellite channel between the UES and the BES determined by "farthest end routing". As a result, change connection is carried out.

(c) When SCU confirms change connection, SCU sends a CCA to SXU.

(d) SXU sends an IAM to the terminating LS.

(C) Phase 3

(a) When the terminating LS receives the IAM, it distinguishes whether the called party is a satellite subscriber. If the called party is a satellite subscriber, the LS sends a CCR to SCU. If the layer-1 is not activated, a satellite channel for D-channel is set up with layer-1 activation.

(b) SCU carries out change connection again and establishes a satellite channel between the originating UES and the terminating UES. After that, SCU sends a CCA to the terminating LS.

(c) The terminating LS sends SETUP to the called terminal. Finally, a communication path is established.

6. RADIO SYSTEM FOR DYANET-II

DYANET-II has been designed to offer communication channels at rate of B-channel (64kb/s) to H1-channel (1536kb/s) for the application to ISDN. The TDMA approach is the most appropriate to handle multi-speed traffic and adopt access channel splitting control(5). Though the TDMA scheme requires complicated digital hardware for burst synchronization control, it needs only one modem for various bit rate transmission if the bit rate is lower than the modem transmission rate. In addition, recent advances in LSI implementation reduce the size and cost of the TDMA equipment. Considering the above, DYANET-II adopts the TDMA scheme instead of other multiple access schemes such as FDMA.

The bit rate, modem scheme and FEC for the TDMA system have been optimized, taking into account antenna size and HPA output power for installation of an earth station on customer premises.

The computer and hardware simulation results show that the best compromise is two carrier transmission, each of which carries 17.6Mb/s signals, per 27MHz band width transponder with transmitting power control. To achieve high spectrum utilization efficiently, offset QPSK has been employed. Carrier (transponder) hopping has been adopted to increase the transmission capacity of the TDMA system and to ensure connectivity among earth stations.

In DYANET-II, there are three kinds of earth stations, as described previously. Table 1 shows the major radio system parameters.

7. CONCLUSION

An advanced satellite communication system for ISDN subscriber and trunk applications, which is integrated into a terrestrial ISDN, has been achieved using new developments in novel network control technologies.

ACKNOWLEDGMENT

The authors would like to thank Dr. Tetsuaki Egawa of NTT Communication Switching Laboratories and Dr. Yoshiteru Morihiro of NTT Network Systems Development Center for their guidance and useful suggestions. The authors also thank the participants in the development of DYANET-II for their great contributions.

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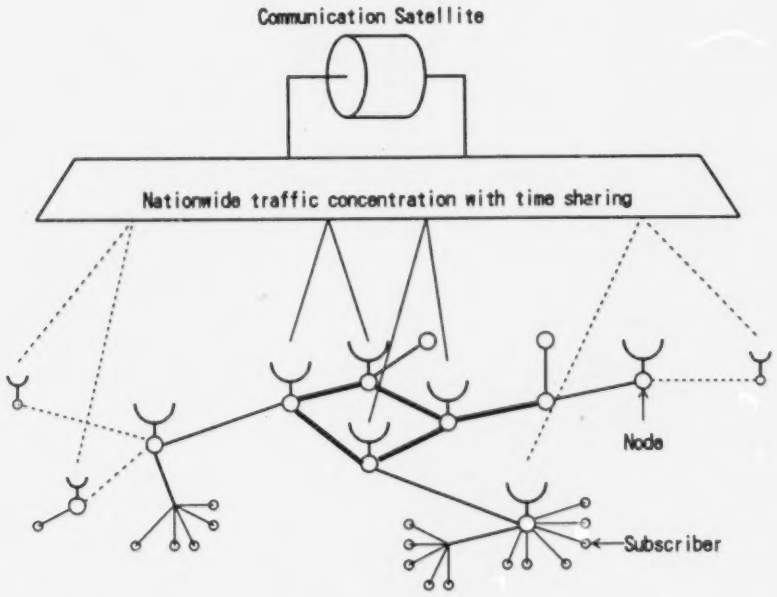


Fig. 1 Traffic Concentration via Satellite

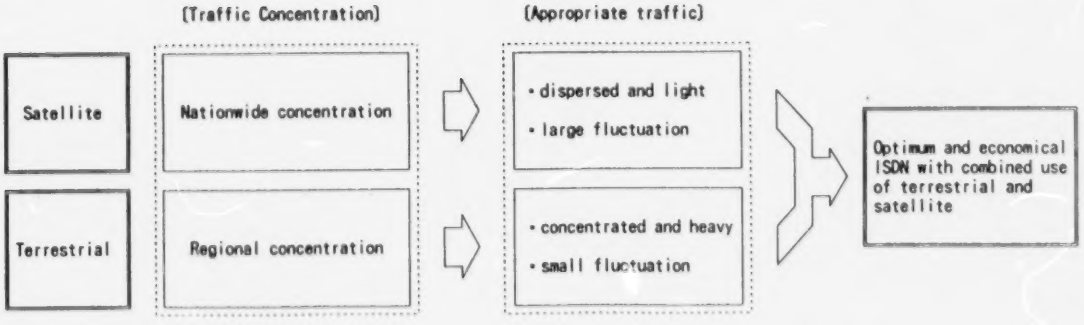
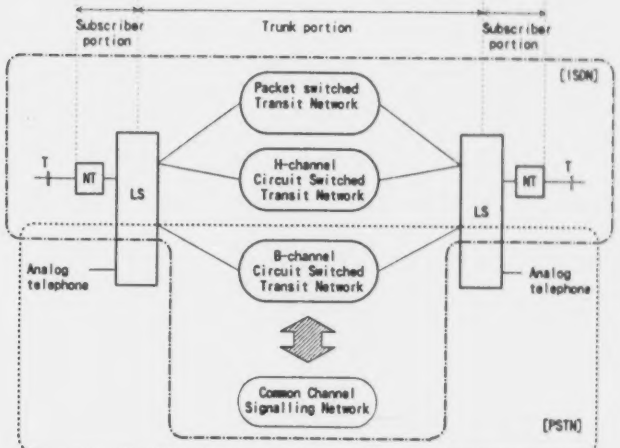
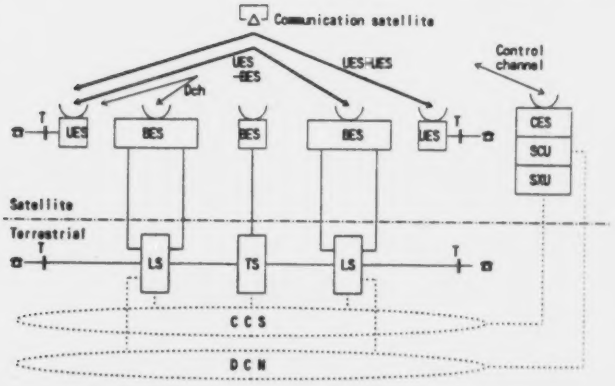


Fig. 2 Features of satellite and terrestrial communication systems



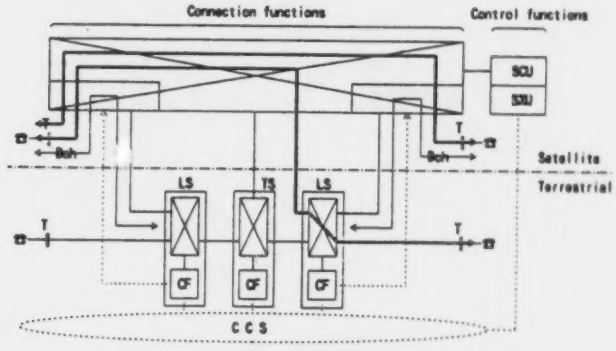
B-channel: for 64kb/s bearer rate
H-channel: for 384kb/s and 1.5Mb/s bearer rate
LS : Local Switch
NT : Network Termination
T : T Reference point

Fig. 3 Network Configuration of ISDN in Japan



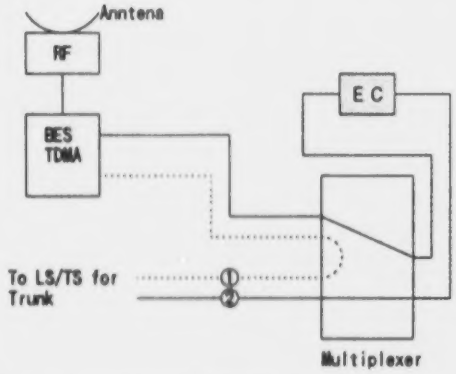
BES : Base Earth Station
UES : User Earth Station
TS : Transit Switch
LS : Local Switch
CCS : Common Channel Signaling network
DCN : Data Communication Network for satellite channel control on a Subscriber portion
CES : Control Earth Station
SCU : Satellite Channel Control Unit
SXU : Satellite Communication Transit Exchange Unit

Fig. 4 System Configuration of DYANET-2



□ : Connection functions on a local access portion
CF : Control functions
····· : Satellite channel control on a local access portion

Fig. 5 Equivalent model of DYANET-2



① : For non-restricted bearer call
② : For audio/speech call
EC : Echo Canceller

Fig. 6 Terrestrial network interface for trunk circuit

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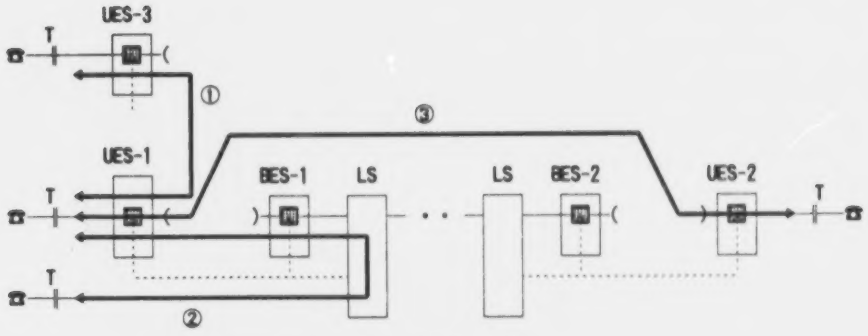

Fig. 7 Examples of connection and echo control for satellite subscriber

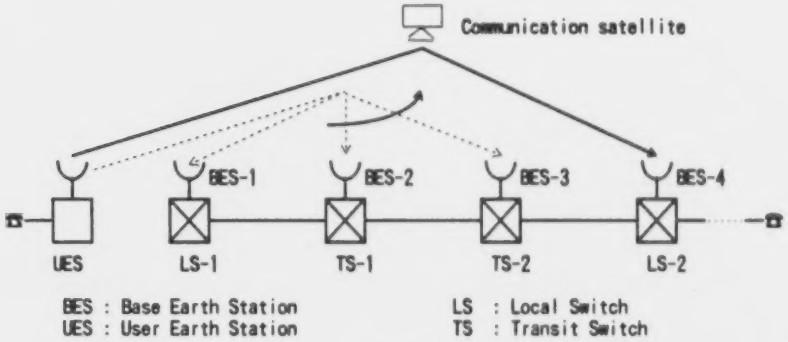

Fig. 8 Farthest end routing

Table 1 Major system parameters of DYANET-II

Frequency			Ku Band
Access Scheme			Carrier (Transponder) hopping demand assignment TDMA
Earth Station	BES or CES	Antenna	6.5mφ or 4.2mφ Dual beam antenna
		Transmitter	45W output
	UES	Antenna	1.8mφ or 2.4mφ antenna
		Transmitter	24W output
	TDMA	MODEM and FEC	Offset-QPSK coherent demodulation with R=7/8, K=7 Convolutional encoding-Viterbi decoding
		Clock rate	8.8 MHz (information rate:10.24 Mb/s)

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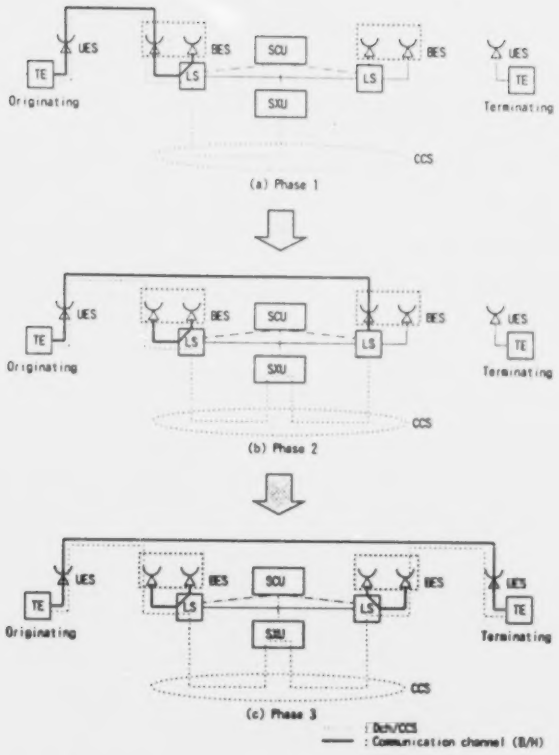


Fig. 9 Connection Establishment Procedure with Change Connection

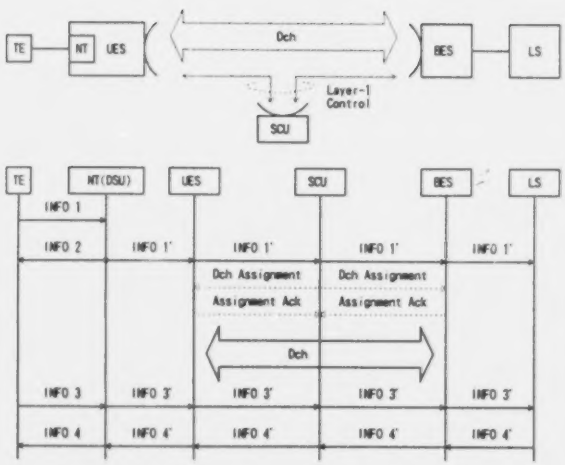
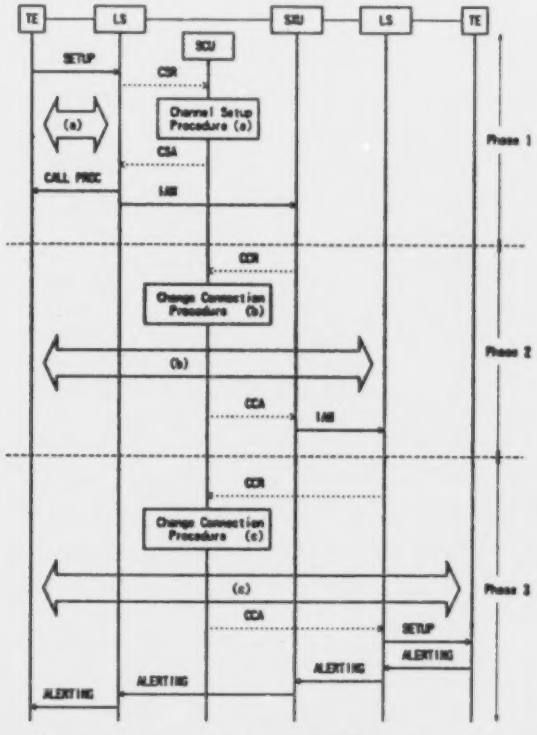


Fig. 10 Layer-1 Activation Procedure via Satellite



CSR : Channel Setup Request
CSA : Channel Setup Ack
CCR : Change Connection Request
CCA : Change Connection Ack

Fig. 11 B/H-Channel Set-up Procedure

An Advanced Network Control System for ISDN Satellite Communication System

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1. ABSTRACT

This paper proposes an advanced network control system for satellite communication systems that are integrated into a terrestrial public telecommunication network. The key technology is a centralized network control system for ensuring single-hop connection and achieving efficient satellite channel use. The network control system consists of multiple satellite channel control units (SCUs) and a satellite communication transit exchange unit (SXU). This control system controls satellite channels according to requests from terrestrial switching nodes. Functional requirements for the proposed network control system to expand the application of satellite communication systems to ISDN subscribers and local switching systems are discussed and a new network control technology is proposed in this paper.

2. INTRODUCTION

Satellite communication systems feature wide area coverage, easy link establishment, and so on. Because of such features, satellite communications have been introduced for communication links to remote islands, and for temporary or emergency use.

Since the launching of Japan's communication satellite CS-2 in 1983, satellite communication systems have been introduced for the above purposes in Japan. NTT developed a new domestic satellite communication system called "DYnamic channel Assigning and routing satellite aided digital NETworks (DYANET)" and introduced this system using the CS-3s launched in 1988. The DYANET has been applied mainly for transit links in the public switched telecommunications networks (PSTN) (1) (2) (3).

This paper describes the functional requirements and key technologies of the proposed network control system for expanding the application of satellite communication systems to ISDN subscribers and local switching systems. Ordinary satellite communication systems set up fixed satellite links between communication nodes. Such systems cannot concentrate traffic, so the satellite channel utilization is very low and the number of applicable satellite links is small. Also, satellite links have a propagation delay of about 250 ms in single-hop connection, so we need to avoid multiple-hop connection in one call as much as possible. However, in ordinary satellite communication systems, multiple-hop connection cannot always be avoided.

We have resolved these problems by adding new functions to DYANET. First, we describe the fundamental concept of DYANET, and the functional requirements for expanding applications. Then, we study link control technology for multiple satellite communication systems, furthest-end routing technology, connection control technology for subscriber calls with single-hop connection, and connection control technology for local switching systems.

3. FUNDAMENTAL CONCEPT OF DYANET AND FUNCTIONAL REQUIREMENTS FOR EXPANDING APPLICATION

3.1 FUNDAMENTAL CONCEPT OF DYANET

In the DYANET system, overflow traffic from many terrestrial transit sections will be carried by the satellite communication system by using terrestrial channels as the first routing channel group and satellite channels as the second routing channel group. In this case, satellite channels are used as one common channel group for transit traffic fluctuations in all transit sections. By using the DYANET system together with the terrestrial network, we can make public telecommunication networks more flexible, cost effective and reliable.

The system configuration of DYANET and its equivalent model are shown in Figure 1. DYANET applies a demand assignment TDMA (Time Division Multiple Access) scheme with transponder hopping capability. In this scheme, a satellite channel is established by having an ES transmit a burst signal over each channel in an assigned time slot. This function can be regarded as a time division switching network. DYANET is equivalent to a large dispersed transit switch consisting of many earth stations (ESs) and satellite control systems (CSs).

In applying such an equivalent transit switching system with a call connection function to existing services (B channel audio/speech/unrestricted digital and H channel) and the existing signaling system (CCS No.7 ISUP), we integrated DYANET into PSTN without adding any new functions to the existing switching systems. Satellite control systems have two main functions: one is assigning and setting up satellite channels between ESs on a call-by-call basis, and the other is selecting a terminating ES and TS, establishing satellite channels between transit switches (TSs), and relaying call control signals to a terminating TS. We implement the first function as a satellite channel control unit (SCU), and the second as a satellite communication transit exchange unit (SXU).

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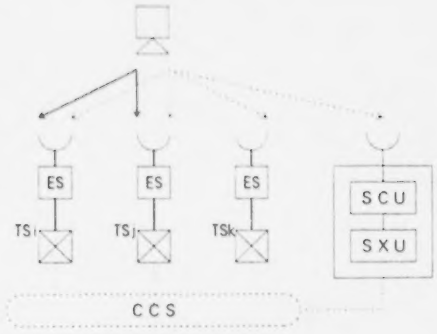
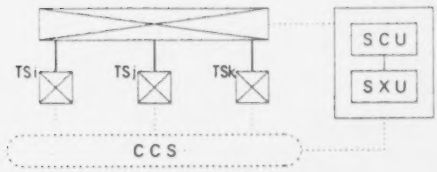


(a) FUNDAMENTAL ARCHITECTURE



(b) EQUIVALENT MODEL

Fig. 1 DYANET SYSTEM ARCHITECTURE

3.2 FUNCTIONAL REQUIREMENTS FOR EXPANDING APPLICATION

As the first step in expanding the DYANET to the PSTN, we have applied the DYANET to 62 Zone Centers (ZCs) in the nation-wide ISDN transit network. There are several requirements for applying satellite communication system to the existing network.

(i) Applying satellite channels to final trunk circuits for local switching nodes (GC: group center, or UC: unit center) on remote islands (switching nodes with final trunk only)
(ii) Applying satellite channels to second route transit trunk circuits between UC and GC for high reliability (switching nodes with double routes)
(iii) Applying satellite channels between a transportable earth station and a transit node for temporary or emergency use (transportable switching nodes)
(iv) Applying satellite channels to ISDN subscriber access portions for rural areas.

Satisfying these requirements, it is necessary to consider the features of the satellite communication system and the PSTN.

(1) Integration of multiple satellite communication systems
Satellite communication systems vary in certain categories (bit rate and transmission frequency etc.) according to their purposes, which makes interconnection or resource sharing difficult. In satellite communication systems, single-hop connection and high satellite channel utilization rate are strongly desired. Thus a centralized control scheme is needed to integrate multiple satellite communication systems into the PSTN.

(2) Integration of subscriber access portion and trunk portion
When we apply a satellite channel to the subscriber access portion, double-hop connection may occur in connections between satellite subscribers or between a satellite subscriber and a satellite trunk. To avoid such double-hop connections, technology that provides single-hop connection between satellite subscribers or between a satellite subscriber and a satellite trunk is essential. (Figure 2)

(3) Call connection control technology for supplementary service calls for application to local switching nodes
For trunk applications between ZCs, general transit calls are the only type of calls handled. For trunk applications in local switching nodes such as UC or GC, however, call connection control technology for supplementary service calls, such as 1XY and 0AB0, is needed. Furthermore, existing analogue signaling systems (such as a channel associated signaling system) are additionally implemented by a satellite communication network control system.

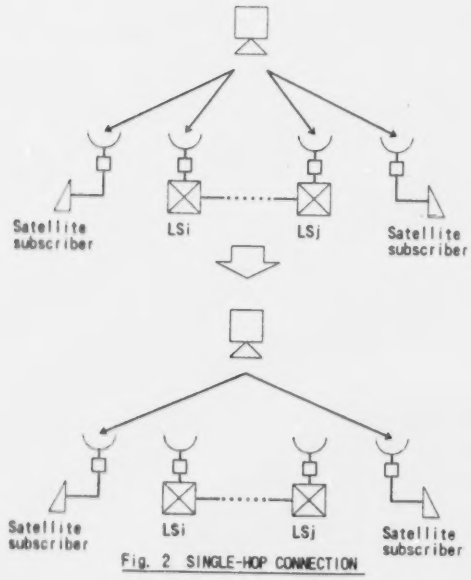


Fig. 2 SINGLE-HOP CONNECTION

4. CALL CONNECTION CONTROL IN DYANET

4.1 SATELLITE NETWORK ARCHITECTURE

Satellite communication systems differ in transmission frequency, bit rate, type of communication satellite, and so on. Direct accommodation of transit trunks of B channels and H channels and subscriber lines is considered one application. In Japan's present domestic communication satellite, interconnection of different types of earth stations is not possible, but improvements in the satellite itself, for example

adding an on-board cross-strapping function, will allow such interconnection in the near future. When such improvements are made in the satellite, we should add new functions not to the existing PSTN, but to the satellite network control system.

Also, the desirability of expanding the satellite network control system independently of advances in satellite communication technology, switching technology, and network technology should be considered in discussions about function assignment between the SXU and the SCU. As there are multiple types of satellites and earth stations in various phases of development, these functional additions should be assigned to the SCU. And the SXU should expand the utilization of the interface with existing switching systems and integrated routing among multiple satellite communication networks. An architecture for an advanced network control system for an ISDN satellite communication system is shown in Figure 3. As shown in Figure 3, there are several kinds of satellite speech path network corresponding to multiple types of ESs and SCUs, which are controled by the SXU. Such control is achieved by the following functions in the SXU.

(i) Deciding a satellite speech path network which is possible to connect between incoming and outgoing calls
(ii) Managing satellite channel resources conditions of every type of satellite speech path network
(iii) Maintaining a list of relationships among types of satellite speech path network in accordance with future integration of these networks (Figure 4)

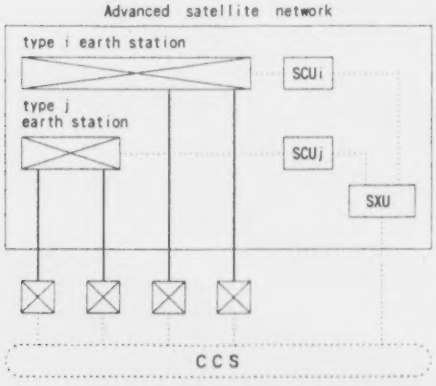


Fig. 3 ADVANCED SATELLITE NETWORK ARCHITECTURE

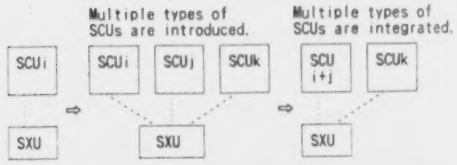


Fig. 4 FUTURE FORM OF VARIOUS TYPES OF EARTH STATIONS

4.2 FARTHEST-END ROUTING SCHEME IN AN ADVANCED NETWORK CONTROL SYSTEM FOR ISDN

There are different types of ESs in an integrated satellite network that are not interconnectable, so the farthest-end ES must be selected out of ESs of the same type.

In existing networks, calls are connected link-by-link in a transit network, and the originating switching node selects a terminating switching node and a trunk circuit. Therefore, a satellite speech path network is decided when a ES is selected out of ESs of different types by an originating node. In this case, the SXU transits the call in this satellite speech path network which was decided by the originating node. On the other hand, if a function to re-select the type of ES were provided to the originating node, it could be possible to select the satellite network to connect with perfect farthest-end routing. The concept of farthest-end routing is represented in Figure 5. A farthest-end route will be decided from the most digits in the list of address numbers which are matching to originating and outgoing ES types. The following alternative routing methods are available.

(I) Individual translators:
By installing translator tables in each type of ES, the originating node can search these tables of ESs which it can connect and decide the channel with the most digits in the list of address numbers.

(II) Common translator:
Regardless of the originating node, by searching all farthest-end points connected to the terminating subscriber, the SXU can select an appropriate farthest terminating route by matching the type of the originating and terminating ESs.

Diagrams of these implementation methods are shown in Figure 6.

Method (I) requires the translator table which is large in proportion to the number of ES types. Method (II) requires twice the memory required by general switching systems, but this translator system can be implemented without regard to the number of ES types. In other words, if that there are more than three ES types, method (II) has advantages in memory size.

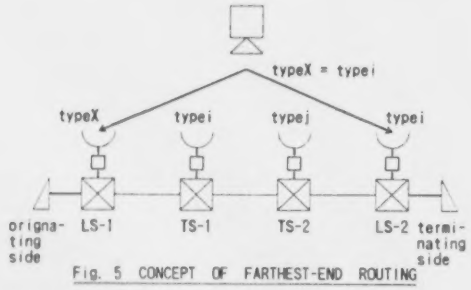
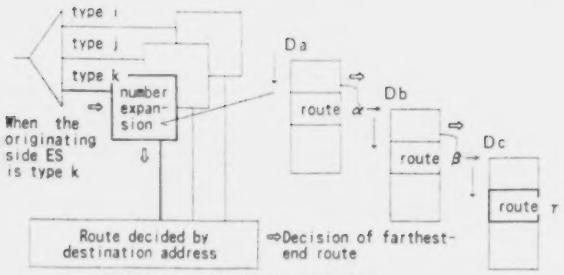
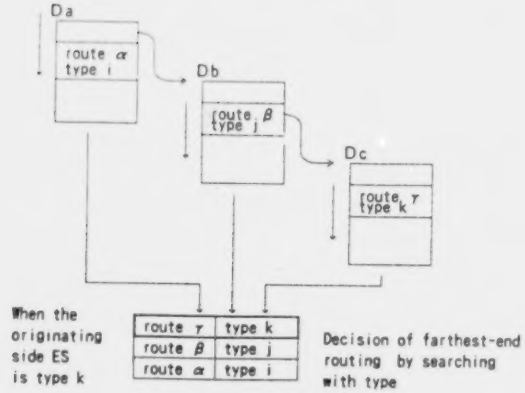


Fig. 5 CONCEPT OF FARTHEST-END ROUTING



METHOD (I) INDIVIDUAL TRANSLATOR



METHOD (II) COMMON TRANSLATOR

Fig. 6 COMPOSITION OF TRANSLATOR

4.3 INTEGRATION OF LOCAL AND TRANSIT CALL CONNECTION CONTROL

To establish satellite channels as subscriber access portion and trunk portion, the following functions are needed.

A) Unifying management of satellite channel resources

B) Unifying requests to set and release a satellite channel to ESs

C) Relaying the information which indicates the satellite channel number connected between a subscriber's ES (UES) and a transit ES(TES)

D) Requesting to change a set satellite channel to another one

E) Identifying from address number, whether a terminating subscriber is a satellite subscriber or terrestrial subscriber

Functions A) and B) are implemented by the SCU; that is, the request to set and release satellite channels for subscriber access portion is sent from local switching system to the SCU. In transit switching systems, functions A) and B) are implemented by sending a request from the SXU to the SCU.

Functions C) and D) are implemented by the SXU and LS; that is, the additional information can be easily sent by CCS No.7 ISUP.

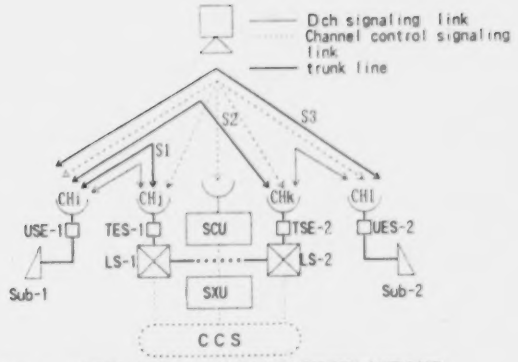


Fig. 7 DIAGRAM OF MUTUAL CONNECTION BETWEEN SATELLITE SUBSCRIBERS

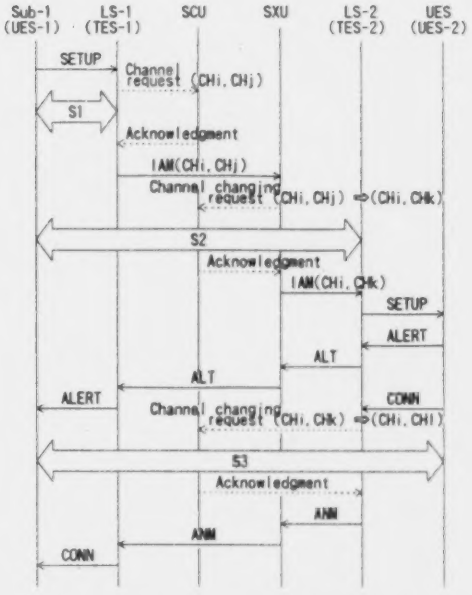


Fig. 8 SIGNALING PROCEDURE OF MUTUAL CONNECTION BETWEEN SATELLITE SUBSCRIBERS

And function E) is implemented by adding new functions only to the SXU; that is, the SXU can identify whether the terminating subscriber is a satellite subscriber or not by checking a list of satellite subscriber's number and type of UES.

A diagram and signaling procedure of mutual connection between satellite subscribers are shown in Figures 7 and 8.

i) The SCU sets the satellite channel between UES-1 and TES-1 since the call is originated from a satellite subscriber.

ii) LS-1 sends call control information to the SXU via CCS No.7 when the terminating subscriber is accommodated to another LS. The channel information used to set the channel between UES-1 and TES-1 is sent as an optional parameter in CCS No.7.

iii) The SXU identifies whether the terminating subscriber is a satellite subscriber or terrestrial subscriber, and classfies the terminating subscriber (satellite/terrestrial) and type of terminating ES. And the SXU selects the channel between LS-2 and TES-2 by farthest-end, which is described in section 3.2. And then the SXU sends the SCU a request to change the satellite channel by sending the channel information of UES-1 and the selected TES-2, and the SXU changes the satellite channel connection from S1 to S2. The channel information which represents the satellite channel between UES-1 and TES-2 is also sent to LS-2 by an optional parameter in CCS No.7, the same as ii).

iv) LS-2 identfies the originating subscriber is a satellite subscriber or not by an optional parameter. When the originating subscriber is a satellite subscriber , LS-2 sends a request signal to set a satellite channel between UES-1 and UES-2, and changes the satellite channel connection from S2 to S3.

4.4 AVOIDING OF DOUBLE-HOP CONNECTION

Although double-hop connection should be avoided as much as possible, there are some cases in which cannot be avoided if connection is to be assured between local switching nodes with final trunk only or between satellite subscribers in the present satellite network which has multiple types of ESs. Thus, the SXU judges the necessity of double-hop connection according to the form of connection, because the SXU decides the routing of a satellite channel. This control is implemented by analyzing the information, such as satellite routing indicator, or subscriber classification (which represents whether the originating subscriber is a satellite subscriber or terrestrial subscriber) and the originating office classification (which represents whether the originating ES is a general office or a local switching office with final trunk only). This control scheme is shown in Figure 9.

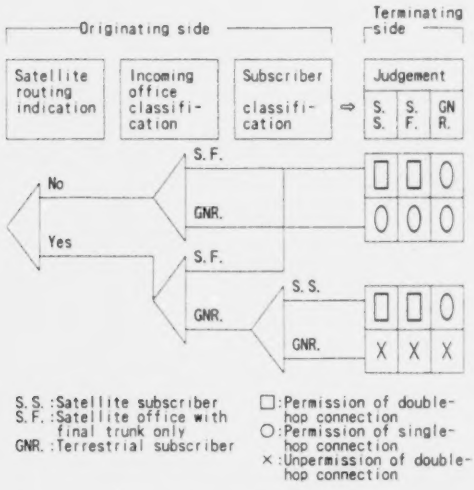


Fig. 9 JUDGEMENT OF PERMISSION OF DOUBLE-HOP CONNECTION

4.5 CALL CONNECTION CONTROL FOR LOCAL CALL

When satellite channels are applied to transit trunks between switching systems of ZCs, the SXU deals only with transit calls. But when they are applied to local trunk portion between UC and GC, the SXU must deal with supplementary service calls and special number calls , such as 1XY and 0ABO.

As each gateway switching system (GS) deals with the selected service calls according to the originating subscriber area, the SXU connects each special call to the closest GS after identifying whether the call is special or not. In particular, the SXU is required to connect each special call to the closest GS in order to connect special calls of all UCs and GCs. Therefore, the originating office classification which can identify whether the originating office is a local switching office with a final trunk only or a general office is needed. The route to the gateway switching system is analyzed and decided in the SXU on the basis of this originating office classification. (Figure 10)

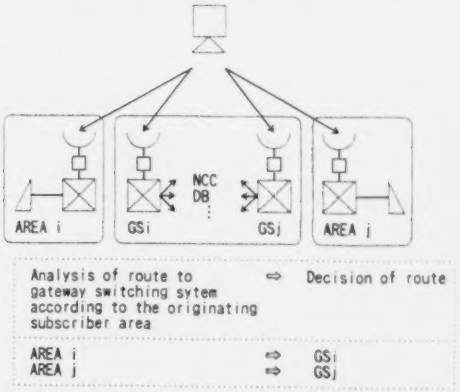


Fig. 10 DECISION OF ROUTE IN SUPPLEMENTARY SERVICE CALL

4.6 APPLICATION TO DIVERSIFIED SIGNALING SYSTEMS

To extend satellite communication systems to local switching systems in UCs or GCs, a channel associated signaling capability is required in addition to a common channel signaling capability. To apply call-oriented demand-assignment satellite channels to the channel associated signaling system, a satellite channel interface unit (SIU), which converts a continuous line signal to/from a frame type signal between an LS and an associated ES, has been proposed.

To receive an address signal in a speech path, the SXU connects the speech path between the SXU and LS directly by using a demand-assignment satellite channel. This method has advantages, such as efficient usage of satellite channels and miniaturization of signal conversion equipment. But as a number of procedures for receiving/sending signals via satellite channels are required, this method has a slight disadvantage: that is, post selection time becomes longer because of the delay in satellite channels and processing time for signal conversion. Figure 11 shows the system configuration for application to the channel associated signaling

system. Figure 12 represents the call connection control procedure . Post selection time is expanded by about 3 seconds as shown in Figure 12. Therefore, application of the channel associated signaling system to the satellte communication system must be minimized as much as possible. If the terminating switching system has CCS No.7 capability, we should use CCS No.7 in the terminating switching system by using the conversion capability of the SXU between CCS No.7 and the channel associated signaling system in order to shorten post selection time.

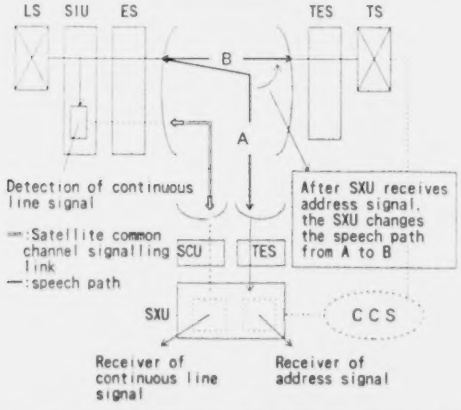


Fig. 11 SYSTEM CONFIGURATION OF DYANET TO APPLY CALL-ORIENTED DEMAND-ASSIGNMENT SATELLITE CHANNELS TO THE CHANNEL ASSOCIATED SIGNALLING SYSTEM

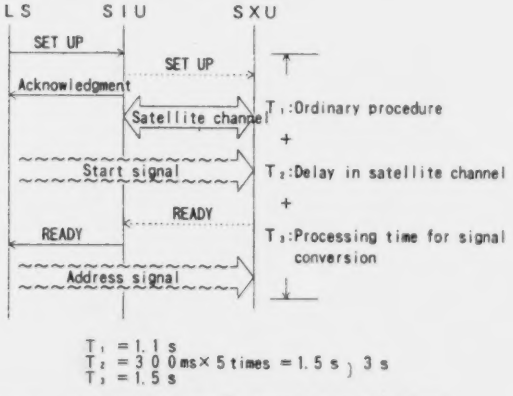


Fig. 12 CALL CONNECTION CONTROL PROCEDURE OF THE CHANNEL ASSOCIATED SIGNALLING SYSTEM

5. CONCLUSIONS

This paper proposes an advanced network control system for ISDN subscriber and trunk applications in a satellite communication system. The key technology is a centralized network control system to ensure single-hop connection and efficient satellite channel utilization. The network control system consists of multiple satellite channel control units (SCUs) that manage satellite channel resources and establish satellite channels between earth stations (ESs) and a satellite communication transit exchange unit (SXU). The SXU is connected to transit and local switches via Common Channel Signaling system (CCS) No. 7 .

Functional requirements of the proposed network control system for expanding the application of satellite communication systems to the ISDN subscriber and local switching systems are discussed and proposed following the network control technologies. Some features are as follows.

I) Integration of multiple satellite communication systems: Several kinds of satellite communication systems that differ according to transmission speed, communications satellite, and so forth, are used in ISDN. Satellite channels are handled by the satellite communication system through the SCUs. The SXU requires multiple SCUs control and routing control based on the matching operation of the satellite communication system. Here, a new translator that can select a direct route to the farthest-end ES from the originating side among multiple satellite communication systems is discussed.

II) Combination of a subscriber access portion and a transit circuit via a satellite channel: The single-hop connection between any two earth stations (user-user ESs, user-transit ESs, and so on.) should be ensured to maintain speech quality. A local switch (LS) with a ISDN subscriber module performs routing control on subscriber circuits and the SXU performs routing control on transit circuits. Depending on the routing control signals sent from LS to the SXU, the SCU establishes and releases satellite channels between ESs on a call-by-call basis. To provide ISDN services on a single-hop basis, a new change connection control using CCS No.7 ISUP and the SXU farthest-end routing, which offers direct connections between satellite subscribers or between a satellite subscriber and a transit circuit of LS/TS, is proposed.

III) Satellite channel switching control for local switching systems: To extend satellite communication systems to local switching systems, the SXU is required routing control and connection control for PSTN supplementary services (operator access calls, new common carrier access calls, and so on.) and the channel associated signaling capability for the connection of analogue switching systems. The translator that routes supplementary service calls to gateway switches according to the originating subscriber area is discussed. To achieve the application of call-oriented demand-assignment satellite channels to the channel associated signaling system, a Satellite Channel Interface Unit (SIU) which converts a continuous line signal to/from a frame type signal between an LS and an associated ES is newly proposed.

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ISDN CENTREX APPLICATIONS IN A LARGE MULTINATIONAL COMPANY

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ABSTRACT

This paper presents seven innovative, cost effective, and productivity enhancing ISDN applications in, or soon to be in, everyday use at the AT&T Bell Laboratories and Network Systems in Naperville and Lisle, Illinois. The site accommodates over 12,000 engineers, managers, and support staff. This six building complex is the largest ISDN Centrex installation in the world. It utilizes 14000 5ESS Switch Basic Rate Interface lines to provide service. The primary work done at the site involves producing Network System switching products.

ISDN provides foundations for the applications described within this paper. Several applications use off-the-shelf Customer Premises Equipment; others use prototype equipment. Each application addresses a specific communications need. These applications represent only a small sample of possible uses of ISDN.

1. Introduction

The future of Integrated Services Digital Network (ISDN) in the US and around the world is being viewed with increasing optimism based on the recent developments in terminal portability, increased deployment, network evolution, and ISDN CPE and applications. This paper provides an overview of six innovative, cost effective, and productivity enhancing applications in, or soon to be in, everyday use at the AT&T Bell Laboratories and Network Systems sites in Naperville and Lisle, Illinois. That complex is the largest ISDN Centrex site in the world with over 14,000 5ESS® Switch Basic Rate Interface lines. Applications presented in this paper include:

— ISDN multipoint,

— ISDN printer sharing,

— ISDN terminal interface card for multiple data sessions,

— ISDN host interface for terminal sessions,

— ISDN telephone call control via data terminal,

— Video Conferencing,

— ISDN service direct to employees' homes.

Each application is described including capabilities, benefits, configuration diagrams, and CPE required.

2. Background

The Indian Hill (IH) Bell Laboratories and Network Software Center (NSC), located in the suburbs of Chicago, is a major AT&T research and development facility. This campus consists of six large office buildings and houses about 12,000 engineers, managers, and support staff. The primary work efforts at this complex consist of large scale switching systems software and hardware design and development, including both the US and international versions of the 5ESS Switch.

In the late 1980's the IH telecommunications organization determined that the existing multiple PBX system did not allow flexibility for growth and user services. They decided to evolve to one integrated system to save administration costs, allow flexibility for growth and provide features across all buildings. After reviewing PBX and Centrex options, the telecommunications organization chose ISDN Centrex from Illinois Bell (IBT) as the best solution to meet all of these needs. AT&T contracted with IBT for 5ESS Switch ISDN Centrex service beginning in April of 1989. This full scale ISDN installation provides service to all six buildings and serves over 14,000 Basic Rate Interface (2B+D BRI) lines (Figure 1). This complex ranks as the largest ISDN Centrex service in the world.

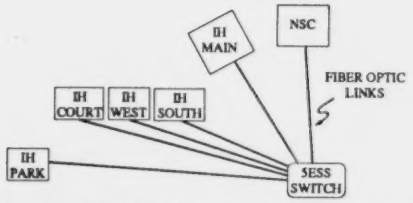

Figure 1. IH/NSC Office Building Configuration

ISDN services such as calling name display, centralized voice messaging, increased conference capabilities, and other enhanced voice features provides a significant improvement in the telephony environment. In addition to these services, new applications enhance the desktop environment, provide video conferencing, and extend the work environment to the home. The following sections describe these applications.

3. Desktop Environment Enhanced by ISDN

The engineer's environment at the IH and NSC sites

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consists of two person offices where each person has a desk, telephone, and a terminal or workstation for interacting with the software development environment (SDE). The SDE platform is a network of mainframe host computers running the UNIX® Operating System. Traditionally, engineers connect their terminal or workstation to host computers via an asynchronous data network.

The introduction of ISDN to the engineering desktop provides opportunities for enhancing the development environment by blurring the boundaries of voice and data communication. The following ISDN interfaces contribute to lower costs and improved communications.

3.1 Multipoint Basic Rate Interface

Multipoint BRI allows up to eight users to share the 2B+D of a single BRI. One user can access both B channels for voice and data calls, or two users can each access one B channel for voice or data calls. All eight users always have access to the D channel for packet data. Unique alerting identifies each user's calls, and users are prevented access to other's calls. Both users can be active on a voice call and multiple data sessions without blocking the other in any way.

Currently, multipoint BRIs supply telephony service to over 200 two-person offices at IH/NSC. Figure 2 shows a multipoint office configuration.

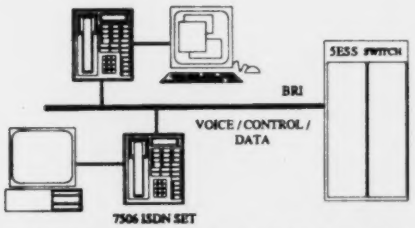

Figure 2. Multipoint BRI Configuration

The multipoint interface adds value by serving multiple users with a smaller amount of switch and building wiring resources. IBT made a two person multipoint BRI available at a cost significantly less than two BRIs.

3.2 ISDN Printer Sharing

AT&T employs a variety of operating systems at this campus. These include DOS, Apple, UNIX®, and IBM.

Traditional mainframe UNIX based systems provide pre-ISDN printing capabilities at IH/NSC. Using asynchronous data networks and Local Area Networks, the UNIX based systems directly control printing. Engineers use the UNIX based system to do software development, support production work, and to do traditional UNIX word processing. If engineers need to develop or co-develop a document, traditional UNIX word processing is still a popular choice.

Often engineers and people in the business management groups use PCs to author individual documents. They use DOS or Macintosh® based software application programs. Such programs include Wordperfect®, Word®, Drawperfect®, Harvard Graphics®, and GEM®. Within this environment, the DOS user community finds ISDN printer sharing gaining rapid acceptance. Printer sharing is economical and useful.

Two vendors supply software applications which allow printer sharing via an ISDN connection. They are Excellnet© and Manylink©. Their packages make ISDN D channel packet look like a local 19.2K serial channel having characteristics of the PC's serial connection. Each package enables a dial-up connection between PCs and supports remote access to a printer connected to a PC. The PC must be running Excellnet or Manylink. The user has the option on whether they would like to dedicate the PC to only service incoming print job or whether they would like to have the PC to concurrently service incoming print jobs and a DOS application. Figure 3 shows how printers can be connected via ISDN.

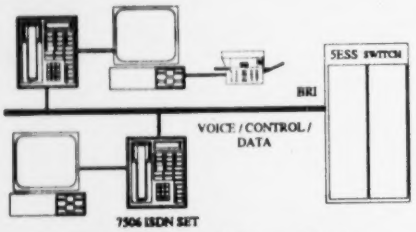

Figure 3. ISDN Printer Sharing

The performance of the ISDN connected printer is comparable to those printers who interface to a PC using a direct serial connection. Naturally, the performance is less than that of a parallel connection. As a result, ISDN connected printers can be sensitive to amount of data associated with the print job. Large ASCII-based print jobs have excellent performance. Large bitmapped print jobs such as a graphics file run slow. Application software provides options which may improve performance. For example one might have the application software produce a lower-resolution graphics print job. Another approach would be to send graphic print jobs to an ISDN connected Postscript printer. Postscript printers provide performance improvement up to 40% for large bitmapped print jobs. People within the work place share laser printers with and without Postscript capabilities. Additional performance improvement is possible when remote printer applications begin to utilize a ISDN B channel packet link across ISDN. This link provides serial speeds up to 64K. The ESP® board produced by Hayes® Microcomputer would enable high speed ISDN based serial data transfers.

ISDN printer sharing is a popular application at the IH/NSC complex. It provides a cost effective solution for providing printer service for small communities of PC users. It provides satisfactory printer performance within the small PC user community. As additional Customer Premise Equipment and software application become available, higher data transfer rates will be available and will enable ISDN printer sharing to approach the performance level of a parallel port printer. This will increase the number of users who share the printer and will continue to increase the number of user communities.

3.3 Multiplexed ISDN Terminal Interface

The 7506/7507 ISDN set provides voice service and data network access. Data network access requires the Asynchronous Data Module (ADM) option. Engineers at IH/NSC use the ADM to connect terminals, PCs, or workstations to host computers using D channel packet switching. The ADM provides host connections for relatively low cost. However, it does not support multiple concurrent connections. Multiple concurrent connections are important in the highly distributed development environment at IH/NSC.

Many engineers use the AT&T 730 Multitasking Terminal with Graphics (MTG). The MTG is a high resolution, multi-window, multi-host, programmable graphics terminal. It allows up to three asynchronous interfaces for host connections and can display seven virtual terminal windows for each host connection. This makes is an attractive solution to the distributed host connection problem. This terminal is in extensive use at IH/NSC, with over 4000 in place as of mid-1991.

Since the introduction of ISDN service, many users of the 730 MTG began to consider how this terminal and ISDN could be combined to provide even greater capabilities. Their solution was the ISDN Data Module (IDM). The IDM fits into an existing expansion slot in the MTG. It provides an ISDN BRI connection to the switch and a second BRI connection to an ISDN telephone. Figure 4 shows the 730 MTG with the IDM card the attached ISDN set.

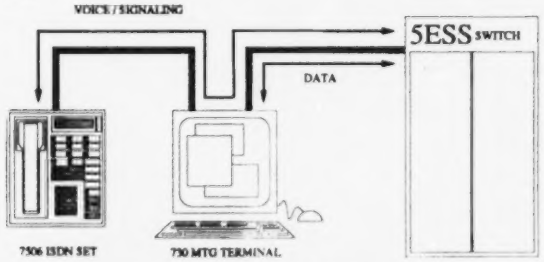

Figure 4. 730 MTG IDM Configuration

Specific benefits provided by the IDM include

- access to eight different hosts simultaneously,
- performance improvements of up to 300% compared to the asynchronous data network,
- reduced network connection costs and clutter.

There is no impact on the capabilities and operation of the voice ISDN set in this configuration. Users of the IDM card have been extremely enthusiastic about the benefits provided. Currently, over 2000 IDM cards are installed and in everyday use.

3.4 ISDN Host Interface

Prior to the implementation of ISDN at IH/NSC, a large asynchronous data network provided over 20,000 terminal and 20,000 host interface connections. At the time of the ISDN cutover, there was no cost effective mechanism to connect host computers to ISDN. The solution was to develop a T1 based interface that uses X.25 on the separate DS0 channels. Each channel supports multiple terminal sessions. This interface uses a standard 5ESS Switch feature known as X.25 Access on a T1 (XAT). The T1 terminates on a SUN4-based Front End Processor (FEP). The FEP connects to the UNIX mainframe via an IBM compatible channel interface. This full duplex connection supports asynchronous terminal to host sessions at rates up to 19.2 kbps. This X.25 host interface provides an end-to-end error and flow controlled connection required for the windowing application benefits discussed in the previous section. Figure 5 shows the ISDN host interface.

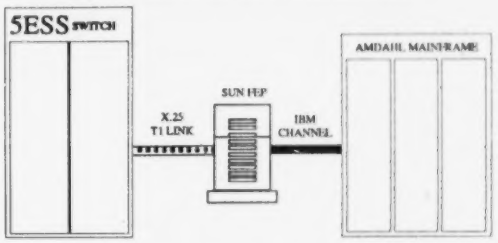

Figure 5. ISDN Host Interface Configuration

Currently, 20 mainframe hosts have one or more ISDN host interfaces supporting terminal sessions. Over 300 simultaneous terminal sessions are supported on each host interface. In the future, we expect this configuration to support all terminal-to-mainframe traffic at the IH/NSC site.

3.5 Voice Feature Control Applications

The serial interface to the 7506/7507 ADM provides access to data connections on the network. In addition to providing the data connection, the ADM can be used to control voice features associated with the 7506/7507 set. The latest generation ADM implements an extended Hayes-compatible Application Programmer Interface (API) protocol that allows complete control of voice features on the set. API applications provide significant extensions of voice features. Figure 6 shows a windowing terminal connected to the ADM via the serial port in the base of the ISDN set.

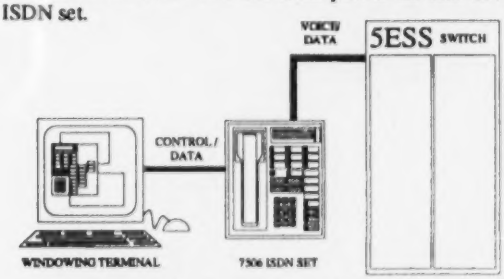

Figure 6. Voice Feature Control Configuration

The API specifies a rich set of control and status messages that a windowing terminal or PC application can use to

- monitor display messages, button presses, lamps, signals, network call progress, and call status;
- simulate button presses and display messages;

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- control the speakerphone, lamps, alerter, and auxiliary equipment;
- provide access to "virtual" buttons not physically present on the set.

Currently, several applications based on API capabilities are in daily use at IH/NSC. They range from simple call tracking systems for help desk operations, to simulation of users exercising voice features on 5ESS Switch lab test models. By far the most popular application to date is a personal telephone manager that provides a graphical user interface to the usual voice features of the 7506/7507 set, with enhanced call management features. It runs under the UNIX Operating System on the 730 MTG terminal or any terminal running X Windows.

The graphical user interface of the personal telephone manager duplicates the layout and functionality of the 7506/7507 on the screen. Using the mouse pointing device to select a graphical button on the screen is equivalent to pressing the corresponding button on the phone. The user can move or delete buttons from the screen. The user can create buttons to provide new functionality, such as dialing calling card numbers or feature access codes. Pop-up dialogue windows provide on-line help or special functions such as electronic directory query. For incoming calls, the incoming caller identifier (ICLID) is used to retrieve and display detailed information on the calling party from corporate databases.

The user may define pop up speed call menus in a startup file. Incoming and outgoing calls may be logged in a file, whether or not the call was completed. This call history is available through special speed call menus, providing quick access to calls missed. If a phone number shows up in an electronic mail message or other on-line document, it may be selected with the mouse and dialed automatically.

Other potential capabilities for the personal telephone manager include

- call notebook, where pop-up windows manage notes pertaining to calling or called people;
- personal conference call management, where conference calls are set up under program control;
- call forwarding to a pager with touch tone interface;
- incoming call screening for per-caller forwarding or ringing patterns.

Software development is the primary activity at IH/NSC, and the computing environment provides the ability to communicate textual information among the development community. The ADM API provides a long sought link between the computing environment and the voice communication environment, enhancing both worlds.

3.6 The ISDN Workstation

Combining the capabilities described up to this point results in an ISDN work environment (Figure 7) that is cost effective, has high performance, is user friendly, and provides the tools to allow the engineer to be more productive.

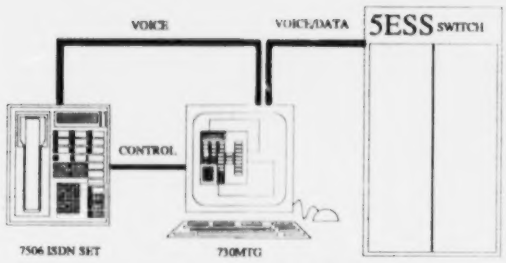

Figure 7. ISDN Workstation

4. Videoconferencing

Videoconferencing is touted as a big cost saver because it reduces travel expenses. Actual savings vary for each company, depending on the amount of travel eliminated. At IH/NSC, videoconferencing saves time, adds efficiency to day-to-day operations, and enhances communications amongst members of the work community and with customers. Technology has progressed to the point where combined voice and video signals can be compressed to 128kbps. As a result, videoconferencing between IH/NSC and other locations can be economically provided. Two services take advantage of this economical bandwidth. One service is conference room videoconferencing. In addition, a service trial of personal videoconferencing is in progress.

4.1 Personal Videoconferencing

Personal videoconferencing is face-to-face video where each person looks at the other's face. Motion during this style of communication is limited making the video signal suitable for compression. The personal videoconferencing service uses requires two B channels. One B channel is dedicated to video, the other is dedicated to audio. This allows videoconferencing across 64K B channel. Prototype CPE is used for this trial.

In the first half of 1992, twenty personal video phones will be set up among corporate managers between different buildings at IH/NSC. Each manager will have a video unit on their desk. Figure 8 shows the components of the unit.

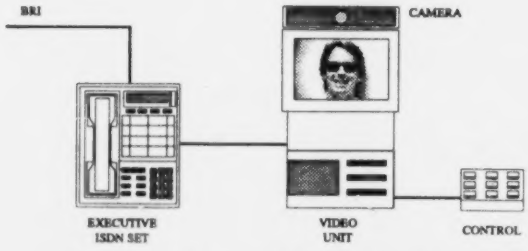

Figure 8. Personal Video Configuration

The video unit contains a color liquid-crystal display, camera, and control key pad. The unit has two video transmission modes: full motion and high-resolution still frame. An optional graphics stand can be used with the phone to provide the remote display of documents, diagrams, and pictures.

The personal video trial will last for 12 months. During this period of time, usage data will be collected and analyzed. Expected benefits of this service include

- saving of executive travel time between offices,
- enhanced communication resulting from eye-to-eye contact, and
- the ability to simultaneous view the same visual information.

4.2 Conference Room Videoconferencing

Conference Room Videoconferencing is group to group interactive video conferencing where people in geographically separated sites see and hear each other in real time. In addition, diagrams or transparencies shown in one room can be viewed in the far room. The advantage of a videoconference room network grows as the distance between conference sites grows and greater travel time and costs can be avoided. As mentioned above, the video and voice compression techniques have progressed to the point where acceptable signals can be transmitted on 112 or 128 kbps links. AT&T has maintained higher bandwidth video systems at major sites for several years. Unfortunately, the cost of these systems and links have limited the availability and systems are overbooked or not installed in the desired sites. The lower bandwidth systems have lower cost and are easier to install in a timely manner.

The conference room video system consists of a video camera, conference microphone, video screen, control devices and a document stand. The system can be equipped with additional cameras and video screens if desired. See Figure 9 for the base configuration of the conference room video system.

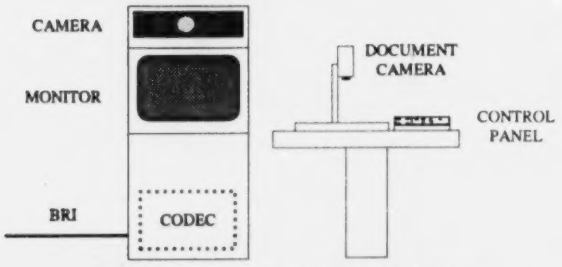

Figure 9. Conference Room Video Station

Currently the lower speed conference room video system consists of systems at IH/NSC, Bell Laboratories sites in New Jersey, and a few AT&T international offices. There are plans to expand the video network to include other Bell Laboratories sites, additional international sites, and possibly customer sites.

Connectivity within the IH/NSC site is provided by the ISDN. Connectivity to New Jersey and international sites are provided by the AT&T Accunet® Switched Digital Service (SDS) accessed via ISDN. ISDN provides a switched access to the Accunet SDS. Switched access allows the concentration of traffic onto access facilities thereby reducing the number required and the cost compared to dedicated facilities. Furthermore, using ISDN as the access vehicle allows the addition of video systems throughout IH/NSC without the long lead time often associated with the installation of dedicated facilities.

5. ISDN Service to Employee's Homes

With advances in ISDN applications and CPE like those described in this paper, ISDN service to people's homes is an exciting option to consider. This service is both economical and technically feasible today. Indeed, it is a reality for many AT&T employees at IH/NSC.

One challenge to offering this service on a subscription basis is its limited availability on switches that services our employees homes. Initially less that 15% of our employees were eligible for the service. If people were serviced by an RSM or the loop did not qualify based on distance, they could not get the service. Ameritech plans to expand ISDN service offerings in 1992. We expect many more people will become eligible in that time frame. Further, Ameritech announced at the ISDN Forum in Washington, D.C. in July, 1991 that it plans to have 87% of its lines configurable with ISDN by the end of 1994.

The key benefit of this service is the high speed data access. Placing an MTG terminal equipped with an IDM card in an employee's home provides them with 16 kbps data service to the host computers resident at the work location. Individuals who do not have the IDM application at home use 9600 bps service through the ADM RS232 option on the 7506 ISDN telephone. By increasing the data rate from 1200 or 2400 bps to 9600 bps or 16 kbps, this service makes terminal work from the home equivalent to facilities at work. Working from home provides a highly productive environment, free of the interrupts commonly experienced in the work environment. Employees with ISDN service are better able to meet their work commitments without having to stay late or spend their weekends in the office.

Service to the home was particularly useful in the following cases:

- Staff who are on call in support of major computing facilities such as labs or major computing facilities.
- Field support staff who are on call and need terminal access to rapidly resolve customers' problems.
- Staff who need out of hours terminal access to computers or switches at other locations.
- Staff where flexibility is needed due to family situations (such as children or elder care situations).
- Staff or managers who do several hours per week of terminal work at home.

The cost of ISDN services compares favorably with the cost of modem pool service. ISDN service is superior to modem pool service in the areas of reliability, throughput, and functionality. For these reasons, ISDN is the preferred mechanism for providing data service to employees homes. The X.25 Closed User Group (CUG) mechanism provides security for this service. If a user is not a member of the CUG, access is denied. The service is supported by provisioning and billing mechanisms provided by the local telecommunications organization in conjunction with

Illinois Bell Telephone.

This service opens the door to providing a rich variety of applications to employees at their homes. This includes video using narrowband video equipment that is becoming available today.

6. Summary

This paper presents seven innovative, cost effective, and productivity enhancing applications in every day use at the IH/NSC AT&T Illinois facility.

Multipoint allows up to eight users to share a single BRI's 2B+D channels. It requires fewer switch and building wiring resources. IH/NSC uses this interface to provide a cost effective office configuration. Two people share one BRI to meet their voice and data needs.

ISDN provides a cost effective way to provide relatively high speed remote printing. The advantage to ISDN is the ability to share the costs of the data connection with a voice connection.

ISDN substantially improves the desktop environment at IH/NSC. The ISDN Data Module (IDM) significantly expands the 730 MTG terminal's ability to connect simultaneously to different hosts computers. Before the IDM, the 730 MTG could simultaneously connect to up to three hosts. This required two additional terminal's serial cards and three access ports from the Asynchronous data network. The IDM terminates the BRI directly and allows each users access to eight different hosts simultaneously using the D channel. The ISDN Host Interface services terminal to host sessions for the majority of users. The Host Interface uses a standard 5ESS Switch feature known as X.25 Access on a T1 and SUN4-based Front End Processor. Each host interface supports over 300 simultaneous terminal sessions. The interface provides each terminal session a full duplex 19.2 kpbs asynchronous connection and end-to-end error and flow control. The ISDN Voice Feature Control Application uses the graphics ability of the 730 MTG and APIs of the 7506 ISDN set to provide alternate way to access 5ESS switch features. Using a mouse pointing device, the user can select buttons on a screen layout of the 7506 set. This action provides the same result as physically pressing buttons on the 7506 ISDN set. For incoming calls, ICLID can be used to retrieve and display detailed information on the calling party from the corporate data base. Incoming and outgoing calls may be logged. Missed calls may be retrieved. When reading e-mail from the host computer, one can use the mouse device to select and dial the telephone number in the e-mail address. The ISDN Workstation combines the IDM and Voice Feature Control capabilities to provide a high performance and user-friendly desktop environment with additional connectivity and tools to allow the engineer to be more productive.

Technology has progress to the point where combined voice and video signals can be compressed to 128kbps. Two services in use at IH/NSC take advantage of this economical bandwidth. Personal videoconferencing is a trial service set up amongst twenty corporate managers to provide face-to-face video/audio communication. Expected benefits include reduce travel time and enhanced communications. Conference room videoconferencing provides group-to-group interactive video where people separated by distance see and hear each other in real time. Multiple sites are set up and operational. ACCUNET Switch Digital Service interconnect each using 112 kbps switch service. Expected benefits include reduced travel time, reduced cost to travel, and easy access to human resource when required.

ISDN service to employee's home is a reality for employees at IH/NSC. This service provides employees ISDN access to the full 5ESS production environment from home. Prior to ISDN service at home, employees connected to the 5ESS production environment via 1200/2400 baud modems. This restricted environment allowed low speed access to one host computer. With ISDN service, employees have high speed access to up to eight different hosts. Working at home provides a highly productive environment, free of the interrupts commonly experience in the work environment.

ISDN provides the foundation for several cost effective and productivity enhancing applications that are in widespread use at the IH/NSC. Some applications are provided via of-the-shelf products. Others have been developed as internal tools; hence, are not yet generally available. The concepts behind each application is consistent with ISDN switch features and can be provided via CPE on the market today.

7. Conclusion

ISDN provides a robust foundation that effectively handles a diverse set of communication needs within our large multinational company. ISDN delivers cost effective voice, data, and video that can be easily mixed and matched to meet many communication needs. The applications presented here represent a small sample of possible uses of ISDN. With these initial applications we begin building our future corporate communications environment. This work sets the stage for a shift in paradigm of how people communicate as we move into the 21st century. Only one's imagination limits the possible uses of ISDN.

Authors:

Alan Hastings received a BA in Mathematics in 1979 from Earlham College and a MS CS in Software Theory from Stanford University in 1985. He joined Bell Laboratories in 1982 where he has worked on switching system software, software tools, distributed computing environments, and ISDN application software. He is currently studying video teleconferencing in the Software Production Research Department in Naperville, Illinois.

Joe Heneghan received a BA CS from Southern Illinois University in 1979 and an MS CS from North Central college in 1989. During Joe's career at AT&T he has worked on various switching systems including 1AESS Switch, 4ESS Switch and TSPS. In addition, he has provided customer support for AT&T Computer Systems Networking Products. He is currently a Member of Technical Staff in the ISDN Systems Integration Group.

Terry E. MacGregor received his BSEE and MSEE from Bradley University in 1971, 1972 and his Phd CS in 1979 from Northwestern University. He joined AT&T Bell Laboratories in 1978 as a Member of the Technical Staff responsible for system integrity software development on the first 5ESS. In 1983, he became Supervisor and provided customer support for the 5ESS. In 1986, he became a planner and developer of ISDN software for Data Services on the 5ESS. Mr. MacGregor planned and co-developed many of the Packet Data features on the 5ESS. He is a member of the IEEE and an associate member of Sigma Xi. His research interests include data networking and large scale software development processes and methodologies.

Lorene Steffes is Department Head of the 5ESS® Switch Special Features Department at AT&T Bell Laboratories, Naperville, Illinois that implements 5ESS Switch features on deployed 5ESS Switch software. She also manages an ISDN Applications Project focused on using ISDN applications at Bell Laboratories in Naperville. Since joining AT&T in 1982, she has provided systems programming and support of Large Mainframe UNIX® Systems; supervised a group responsible for providing AT&T required kernel enhancements to Amdahl's UTS®; led initiatives to set directions for the evolution of the AT&T R&D computing environment; and headed the Software Development Systems Department responsible for systems engineering, planning, development, verification, training, and customer support of the tools used by the 5ESS Switch developers. Her formal education consists of a BS in mathematics (1968) and an MS in Computer Science (1982). Both of her degrees are from Northern Illinois University.

Robin Thompson received a B.S. in Mathematics from Manchester College in 1983 and a M.S. in Applied Mathematics from Clemson University in 1985. He began his career with Bell Laboratories in 1985 as a Systems Engineer for the 5ESS Switch and has been responsible for ISDN applications development and customer support for accounts such as MIT, Merrill Lynch, Boeing, Tenneco, Duke University, and the ISDN implementation at the IH site. Following the implementation of ISDN at Indian Hill, he led an ISDN applications forum chartered to investigate and champion ISDN applications for use at Indian Hill. He is currently in the International 5ESS Wireless Applications group and is responsible for data applications planning.

'I-Board 64' for Personal Computer Communication over ISDN

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NTT PC Communications Inc.
Tokyo, Japan

ABSTRACT

NTT PC Communications Inc. provides personal computer communications services conforming to CCITT X.400 series Recommendations. In response to the growing trend towards file transfer-type and interactive database access-type communications, we have developed an ISDN communications terminal utilizing the 'I-Board64', a personal computer communications board allowing transmission over ISDN. It supports all three ISDN communication modes, and enables high-speed data transmission.
This paper describes the background to ISDN terminal development, the state of Japanese standardization for ISDN communications, and the configuration and performance of the personal computer communications terminal over ISDN.

1. INTRODUCTION

As a subsidiary of Nippon Telegraph and Telephone Corporation (NTT), NTT PC Communications Inc. began communications network service for personal computers (PCs) in November 1986. Its network is referred to as the NTT PC Network. Conforming to CCITT X.400 series Recommendations, the NTT PC Network provides value-added network services such as mail boxes, bulletin boards, and realtime connections.

To speed introduction of services and facilitate expansion, system development and introduction were carried out in several phases. Since the first system was established in 1985, functionally expanded systems to enlarge the communication area economically and enable the provision of additional services were introduced in 1988, 1989, and 1990.

The NTT PC Network is mainly for business use, and currently accommodates 30,000 subscribers including 3,000 companies. Study of usage patterns shows two main tendencies. One is file transfer-type communications requiring high-speed data transmission capability. The other is interactive database access-type communications, in which long communication time puts a priority on economy.

NTT's ISDN service started in 1988, offering both high-speed data transmission and the capability of packet-switched service at a low monthly basic tariff. NTT PC Communications' ISDN communications terminal has been developed to process effectively file transfer and interactive communications.

2. THE NTT PC NETWORK

2.1 NETWORK SYSTEM CONFIGURATION

The network structure of the NTT PC Network is shown in Figure 1. As shown in the figure, the message switching center can concentrate traffic from various distances and of different volumes. Users can select the most convenient type of connection.

Many users access the network through the PSTN utilizing analog modem adapters based on the Japanese Unified Standard for Telecommunications-Personal Computers (JUST-PC). Those adapters enable 4,800bps data transmission. A higher-speed V.29 JUST-PC modem adapter, available from NTT PC Communications since summer 1991, gives 9,600bps data transmission speed. The NTT PC Network will soon support communications using new high-speed adapters.

The NTT PC Network operates throughout Japan. We have two message switching centers in Tokyo, and twenty access points have been installed in major cities. Another nineteen access points will be brought into the network by Spring 1992. Private packet-switched networks and leased lines connect access points to the message switching centers. The existing network distribution is shown in Figure 2.

2.2 NETWORK SERVICES

The NTT PC Network provides the following services.

- Mail box service
  All basic service items prescribed by CCITT Recommendation X.401 are provided. Forty of

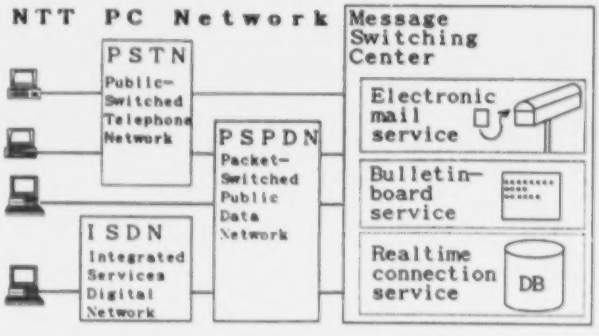

Fig. 1 Network Structure

Fig. 2 Existing NTT PC network distribution

the 48 prescribed options are also supported, including multi-destination delivery, deferred delivery, receipt notification, and media/code conversion services. When direct delivery is made to a G3 facsimile, message text code is automatically converted to graphic image data.

- Bulletin board service
  Users can exchange information using a common memory area based on JUST standards. This service is regarded as an expansion of the Message Handling System (MHS).

- Realtime connection service
  Realtime connection is provided in addition to store and forward services. These services are useful in accessing the information provider's computer centers in the NTT PC Network.

- Security
  Information stored in message switching centers must be protected against any illegal access or violation. Log-in authentication, closed user groups, and notification of most recent access time are designed into the NTT PC Network.

2.3 OBSERVATIONS ON OPERATION

Figure 3 shows distribution of current service usage. Although the bulletin board service made up about 80% of use during the early part of 1988, it presently comprises just over half. The share held by our electronic mail service has increased markedly to 41% from 14.5% in 1988. As users often send binary files via electronic mail, there are huge requirements for file transfer in the NTT PC Network. While high-speed data transmission is available with a V.27ter 4,800bps analog modem, a more economical high-speed data transmission line is required.

Figures 4 and 5 show the distributions of communication time and message lengths. Average call time is seven minutes, a 1.6 times increase over the 1988 figure. While average message length of bulletin board access is twice as long as in 1988, the peak remains around 2KBytes. According to the results of a service usage study, interactive communications are often utilized in bulletin board and realtime connection modes. In interactive communications, a user first checks guidance messages or scans data on his screen. After entering some keywords and transmitting them to computer centers, succeeding messages will be received from computer centers and displayed. Because communication takes considerable time relative to information volume transmitted, the long connection time highlights the need for economy.

As mentioned above, users trend to communicate either through file transfers or interactive transactions. An additional requirement is easy change of access lines, as users want to use both file transfer and conversation type services. For these requirements, ISDN is currently the best solution. ISDN makes available both a high-speed B-channel circuit-switched mode and a B/D-channel packet switched mode. These modes are selected not only call by call, but are also usable simultaneously.

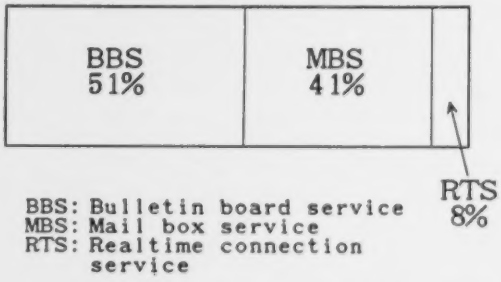

Fig. 3 Trends in service distribution demand

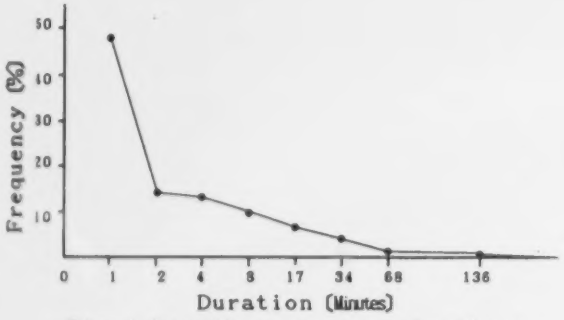

Fig. 4 Duration of communications

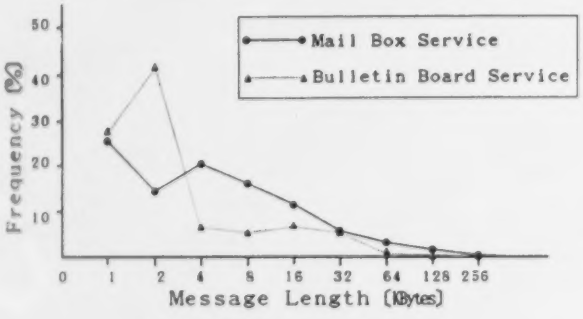

Fig. 5 Message length

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3. STATUS AND BENEFITS OF ISDN SERVICE

NTT has offered its INS-Net 64 basic interface service since 1988, INS-Net 1500 primary rate interface service since 1989, and packet-switched service since 1990. By August 1991, NTT's ISDN accommodated 57,800 lines, up from only 114 lines when the service started. Supported by the falling prices of ISDN peripheral equipment, the number of ISDN users has begun to increase dramatically. With NTT's announcement of ISDN expansion to 2,060 service areas by the end of 1991, the number of users is expected to increase to about 750,000 by Spring 1995.

ISDN has proved its worth to users in a number of ways. For PC communications, ISDN is capable of high-speed data transmission at the same tariff as the analog telephone network. ISDN offers 64Kbps transmission against a maximum 9,600bps in the existing telephone network. This feature is expected to lead to such new ISDN applications as multi-media communication which requires massive data transfer.

In the packet-switched mode, ISDN benefits users through a structure where charges are proportional to information volume, and monthly basic charges are low. Since many users converse with computer centers in online mode, it is desirable to be charged by mass of data transmitted rather than by communication time and to be offered a low monthly basic charge. The proportional tariff of NTT's ISDN packet-switched service is the same as that for Digital Data Exchange Packet (DDX-P) service. The monthly basic charge for the addition of packet-switched service is only about U.S.$8 at minimum configuration, while that of the DDX-P is relatively high. The difference in the monthly basic charge has been a factor behind the increase in ISDN packet-switched service use.

As the number of ISDN users has begun to increase dramatically, the price of ISDN equipment has begun to fall. Furthermore, ISDN will soon be available in all parts of Japan. A continued increase in the number of ISDN users will accelerate the drop in the equipment price resulting in even more ISDN users. From this viewpoint, the development of the ISDN communications terminal for personal computers comes at the right time.

4. JAPANESE ISDN APPLICATION STANDARDS

In conformity with CCITT I-series Recommendations, the Telecommunication Technology Committee (TTC) specified Japanese national standards for ISDN in May 1987. They prescribes the OSI Layers 1 to 3 protocols needed for ISDN terminals to inter-work with the network. Based on TTC ISDN standards, some Terminal Adapters (TAs) and add-in type communication boards have been developed.

For end-to-end communications, a high-layer protocol for application programs is required, and has been specified by manufacturers. To guarantee inter-operability among terminals and provide economical communications, high-layer ISDN communication protocols must also be standardized. To support the existing OSI applications, standardization must be based on OSI reference model.

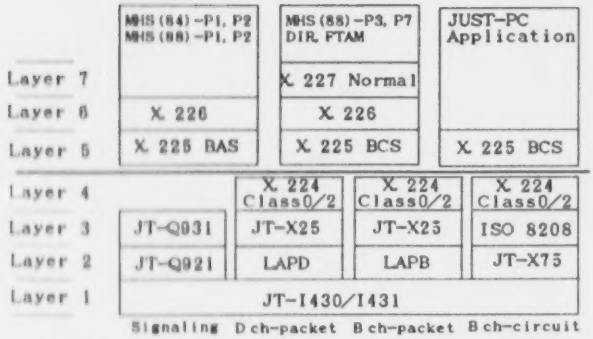

Fig. 6 Protocol structure of JT-PD00

In April 1990, the TTC announced its JT-PD00 series standards specifying OSI profiles for ISDN applications. The JT-PD00 series covers protocol sets from Layers 1 to 7, and is widely applicable to standardized applications such as MHS, directory (DIR), and FTAM.

Figure 6 shows three communication profiles of the JT-PD00 series.

- OSI profile
  The fundamental profile for OSI applications such as P3/P7 (MHS protocols specified in 1988), DIR, and FTAM. It is based exclusively on OSI protocols.

- MHS inter-operable profile
  For MHS functional standards specified by TTC, conforming to CCITT MHS Recommendations.

- JUST-PC profile
  For existing JUST-PC applications.

According to the type of communication path used, there are three types of profiles in Layers 1 to 4. One is for the D-channel packet-switched path, another is for the B-channel packet-switched path, and the last is for the B-channel circuit-switched path. Any higher-layer profiles can be combined with them.

5. ISDN COMMUNICATIONS TERMINAL

5.1 TERMINAL CONFIGURATION

The basic design principle in the ISDN terminal provides for high-volume data transmission. When a PC is the host processor, it is important to save processor power and memory space.

The configuration of the ISDN terminal is shown in Figure 7. An I-Board 64 extension card-type ISDN board is installed in a PC's expansion slot. The I-Board 64 is connected to a host

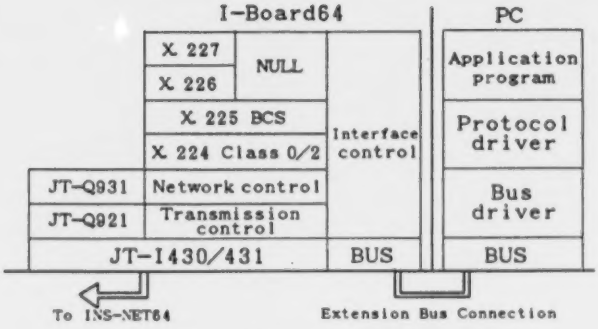

Fig. 7 Configuration of ISDN terminal

processor with a PC extension bus, giving high-volume data transmission between the I-Board 64 and the PC. A 16-bit microprocessor is embedded in the I-Board 64 to deal with Layers 1 to 7 protocol processing.

The first product of the I-Board 64 series supports OSI protocols up to Layer 5. The program interface between ISDN BIOS and application programs is specified according to OSI Layer 5 basic functions. We are now planning to develop two more types, one supporting Layers 1 to 3, the other supporting Layers 1 to 7 (ACSE).

Without the restrictions of ISDN call control and OSI protocol processing, personal computer applications can utilize all three communication modes. Therefore, applications can use 64Kbps high-speed data transmission in B-channel circuit-switched mode, and can also use the packet-switched mode on B and D-channels.

5.2 I-BOARD 64

The structure of the I-Board 64 is shown in Figure 8. The I-Board 64 consists of three blocks: a line signaling block, a control processor block, and a bus controller block. In the line signaling block, there are three signaling control LSIs (one LAPD and two LAPBs), allowing the I-board 64 to simultaneously communicate with all three communication paths. The bus controller enables the host processor in the PC to write and read the information to/from window memory in the I-Board 64. This means that the host processor can indicate commands to the control processor, and can also transfer data to and from the communication path.

A PCM CODEC is installed in the I-Board 64, permitting telephone calls with the attachment of a handset. Any two communication modes can be used simultaneously. For example, an operator can receive a telephone call on the B1-channel while accessing the computer center.

Many IC chips and electronic parts are required to control the ISDN circuit. By installing such parts on both surfaces of the board and packing its two sub-boards close together, the I-Board 64 occupies only one expansion slot.

5.3 APPLICATION PROGRAMS

5.3.1 PROGRAM INTERFACE

The NTT PC Network mainly supports JUST-PC applications, and much application software offers a JUST-PC command interface (CFU). For easy modification of much existing application software to ISDN products, the ISDN BIOS interface has been specified based on the CFU.

The CFU has been specified to control a single channel with a JUST-PC analog modem adapter, while many channel communications are simultaneously available in ISDN. An information header that indicates the communication environment (switching mode, channel number, etc.), is attached to the CFU commands.

5.3.2 ComTALK FOR NTT PC NETWORK ACCESS

As shown in Figure 9, two types of ISDN application software have been developed. One is ComTALK for electronic mail, the other is I-TALK64 for end-to-end file transfer. Using ComTALK, users can access the NTT PC Network for electronic mail and bulletin board services.

The software structure of ComTALK is shown in Figure 10. A modular technique is adopted to maintain software portability. ComTALK operates on MS-DOS, and consists of a human-machine interface module, an MHS protocol handler module, and a device driver module.

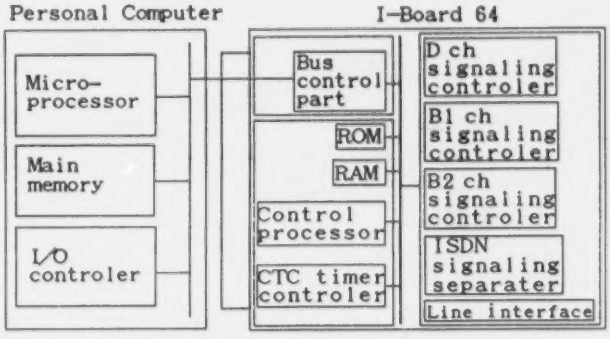

Fig. 8 Configuration of I-Board 64

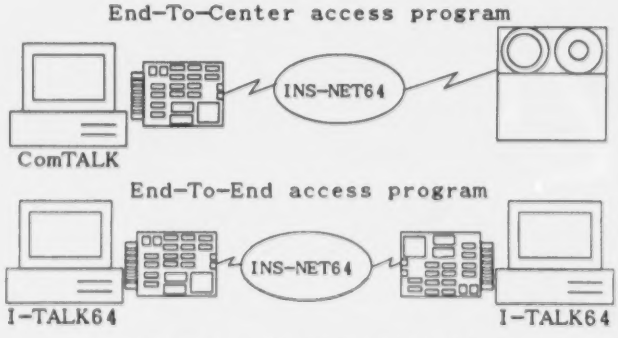

Fig. 9 ISDN applications

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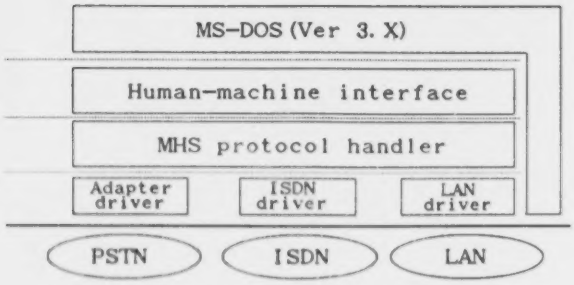

Fig. 10 Software structure of ComTALK

The human-machine interface module provides the environment for mail and bulletin board access. Supported by a cataloged procedure in the human-machine interface module, a user can customize communications procedures. Three device drivers are used for ordinary analog telephone networks, LAN networks, and ISDN. Choosing the appropriate device driver, ComTALK can deal with any of these networks. The protocol handler module supports JUST-MHS, which is specified in accordance with CCITT X.400 series Recommendations.

A packet-switched mode over the D-channel and B-channel is currently available, but the NTT PC Network does not support ISDN circuit-switched mode. A B-channel circuit-switched mode will be supported in the near future.

5.3.3 I-TALK64 FOR END-TO-END FILE TRANSFER

I-TALK64 has been developed to cater to demands for end-to-end file transfer. I-TALK64 directly connects an originating terminal to a destination terminal, and enables an operator to access files in the destination terminal. A circuit-switched B-channel path is usually adopted for high-speed file transfer, but I-TALK64 also supports packet-switched mode.

5.4 PERFORMANCE

Examples of data transmission rates are shown in Table 1. Results are excellent: maximum throughput is 62Kbps in circuit-switched mode, and 7 to 26Kbps in packet-switched mode. NTT's guaranteed level of packet-switched mode throughput is limited to 9.6Kbps.

Table 1 Performance of I-Board 64

	End-To-End	End-To-Center
D ch Packet	10Kbps	7Kbps
B ch Packet	26Kbps	10Kbps
B ch circuit	62Kbps	Now not supported

6. CONCLUSION

This paper has described the background to the need for ISDN communication, the status of ISDN services in Japan, and configuration and performance of the newly-developed ISDN terminal. The I-Board 64 is based on TTC JT-PDOO series standards, and can deal with all ISDN communication modes, in addition to offering communications software for electronic mail and end-to-end file transfer. Performance tests of the I-Board 64 have shown in an excellent 62Kbps data transmission rate.

The NTT PC Network currently only supports packet-switched mode, but it will soon be developed to support circuit-switched mode communications. The I-Board 64 will accelerate ISDN introduction.

Users of the NTT PC Network will benefit from the advantages of ISDN, including faster data transmission and packet-switched mode. The former will aid such file transfer activities as Electronic Data Interchange (EDI); the latter will be useful for interactive communications such as are used in a Strategic Information System (SIS).

To accelerate the introduction of ISDN services, standardization of the interface between ISDN BIOS and the application program is required in addition to standardization of the communication profile. It is also necessary to verify inter-operability among heterogeneous terminals. Those are important problems which need to be overcome.

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GROWTH THROUGH INTEGRATION

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1. ABSTRACT

The communications industry has been impacted by three major factors which have caused it to evolve in the manner as we know it today--regulatory policy, technological change, and the development of computers for networking control. Because these changes are taking place at an increasingly rapid pace, it is important for a system to be flexible in design, thereby permitting new, more efficient means of satisfying customer requirements without necessitating replacement of the existing system and sending an earlier innovator into oblivion.

2. HISTORICAL APPROACH TO DEVELOPMENT

Historically, mobile communications systems have been developed on a stand-alone basis, designed for special applications, and only grudgingly interfaced with other systems. However, this was also true of virtually all communications, since most services evolved to satisfy a single user requirement. Because these systems were designed to meet specific requirements, they did not require standards, and due to existing regulatory policy, were permitted to expand as long as they did not interfere with other systems. Further, due to the slow rate of technological change, they tended to last for long periods of time because there was nothing better to replace them.

U.S. regulatory policy was also instrumental in promulgating this manner of development. Communications was considered a monopoly service, and most communications companies provided only a single service, focused on use of a single technology. AT&T was required to sell off its lucrative TWX service to Western Union Telegraph because it was considered a service more closely aligned with telex. Similarly, AT&T was also required to abstain from developing a data transmission service over its telephony network, with the record carriers being permitted to develop the service over separate networks, creating an artificial line of demarcation. Further, controls were imposed on users, restricting devices which could connect to carriers' networks, ostensibly for the purpose of protecting the network, but often protecting the carrier's revenues by enabling the carrier to impose additional charges for connecting such devices to their network.

3. THE CHANGING ENVIRONMENT

Beginning in the early 1970's, the nature of the telecommunications industry began to change. The U.S. Government, through the Federal Communications Commission (FCC), began to advocate competition. An upstart communications company, Microwave Communications, Inc., obtained approval to provide private line service between cities. Recognizing that this was only a small part of the potential market, the company pressed on and was soon able to provide long distance telephone service, although on a basis less favorable than the monopoly carrier, AT&T. In order to compete, this new entity had to offer substantially lower prices than the entrenched carrier.

During this same period, there were other changes also taking place. For a variety of reasons, including keeping AT&T from dominating communications technology, a new entity was authorized in 1962 to represent the United States in an international organization to be established to implement communications services via satellite. Based upon the controversy over how the company should be established and its role vis a vis the existing telecommunications infrastructure, a compromise solution was evolved which created a new major telecommunications organization. This new company, which represented the U.S. in the International Telecommunications Satellite Organization (INTELSAT), was called the Communications Satellite Corporation (COMSAT), and was able to provide a variety of services over a single network, including television, telephony, leased lines, telex and high speed data. Another event occurred which impacted the forms of communications transmission available, namely the invention of fiber optic cable technology. Both of these new technologies offered lower costs for telecommunications, and resulted in additional competitors coming into the arena.

A third significant change was the recognition that computers would become increasingly more important in communications as automation was used to lower

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costs and increase efficiency. IBM's foray into communications through Satellite Business Systems (SBS) created a threat to AT&T and other carriers that future communications growth would be controlled by this giant. It became more and more difficult to define precisely what was a communications service and what constituted a computer service. The FCC instituted a series of "Computer Inquiries" to try to set rules for the development of both services, never quite resolving things.

Computers were only one of a series of new ancillary communications devices impacting users. Answering machines, facsimile machines, and other innovations demonstrated that new rules were needed. While AT&T was not permitted to provide data services over voice lines, it became clear that customers were not observing the rules and it was impossible for AT&T to enforce them itself. Users required more permissive open architecture in their networks as they tried to make all the pieces capable of interoperating with each other. Further, as customers became aware of alternative means of satisfying their communications requirements at lower prices, a number of carriers found this new competition negatively impacting their revenues, as various services started to decline, first telegram, then telex and datel. Slower speed data services became replaced by more cost-effective higher speeds, enabling users to expand their capabilities substantially for small increases in cost. A down-sizing of the industry followed as companies merged to maintain a sufficient volume of business to justify the continuance of services. The end result became a recognition that the carriers must increase the size of their markets, and to do so, they must be able to offer a greater variety of capabilities to users who wanted to integrate their various specialized networks. Customers also wanted to be able to work with one carrier who would have the responsibility to make everything fit together, rather than have to figure it all out for themselves to make it work.

4. THE MOBILE SITUATION

During this evolutionary period for domestic networked systems, similiar changes were taking place in mobile communications. Maritime communications originally started as morse code telegraphy, and high seas telephony was later added. The high seas telephony service was patched into the domestic public switched network and permitted the two systems to work together. On land, a number of private VHF and UHF systems were authorized to operate on specific frequencies, with calls occasionally patched into the PSTN. All of these services were provided on a manual basis. Again, new technologies evolved which created competition for these systems and the carriers providing the services. In 1976, COMSAT launched its MARISAT system which enabled users to obtain automatic service through the domestic PSTN and the satellite system to remote users. On the land side, a new technology known as cellular telephone also permitted mobile users to directly interconnect to the local telephone networks. The same factors causing upheavals in the domestic networks affected the mobile carriers. HF telegraphy service demand dropped, as users saw the superior capabilities and lower cost of satellite technology, and the HF telephone service saw much of the growth in maritime telephony going to satellites. In response, a number of coast stations were closed in order to permit sufficient volumes of traffic through remaining facilities to make them economically viable. On land, cellular radio telephony was a virtual explosion, vastly outstripping even the most optimistic forecasts of demand. Of interest to this change in use of technology was the development of standards for equipment, which permitted widespread service between equipments of a large variety of manufacturers. The greater competition by manufacturers resulted in lower costs of hardware for users, which, in turn, stimulated demand for the services. This whole process is demonstrated very well in the MARISAT/INMARSAT experience, which is a model of how a communications system can be designed to maintain substantial flexibility to meet changing user requirements.

5. THE MARISAT/INMARSAT MODEL

As was the case for many new start-up ventures, the MARISAT system developed by COMSAT started with an uncertain market. The U.S. Navy required an interim satellite communications capability pending the deployment of its future FLEETSAT system. COMSAT management conceived the idea of coupling this service requirement with developing a new market for commercial maritime satellite services. Building three satellites (one as backup in event of a launch failure) to satisfy a two-year, two-ocean service requirement, COMSAT was able to successfully launch and place into orbit all three satellites, thereby expanding the Navy service to cover the globe. Delays in the Navy program, coupled with increasing requirements, extended the period of the Navy lease, thereby enabling COMSAT to more fully develop the commercial services.

At this same time, activity was progressing towards creating a new international satellite system known as the International Maritime Satellite Organization (INMARSAT). When INMARSAT began commer-

cial service in early 1982, the MARISAT system formed the backbone of the INMARSAT space segment with the transition of all three satellites and a user base of over 1000 ships. Again, on a cost-effective basis, the space segment was implemented with leased satellites to provide sparing and greater capacity made available through larger satellites. Because MARISAT, and later INMARSAT, were capable of providing new and improved services similar to that available through land-based networks, a plethora of new mobile services were tested successfully, including 56 kbps data, compressed television, E-mail, packet data and voice broadcast services.

The allocation of L-Band frequencies for mobile communications also created additional opportunities to respond to user demands and serve additional markets, including land-mobile and aeronautical satellite services, all of which are interconnected to both public and private networks. Recognizing the importance of the Department of Defense Global Positioning System (GPS), a differential GPS service was offered, and plans are being made to provide an aeronautical integrity service with the deployment of the third generation satellite system in 1995.

6. CONCLUSIONS

The purpose of this paper was to provide insights into the need for open architecture in developing communications networks in order to permit users the flexibility of obtaining the benefits of new technology through existing systems without having to completely replace their networks. The effects of changes in technology and regulatory policy have had dramatic impact on the communications industry and its structure. With change taking place at an increasing rate of speed, the expectancy of life of any system is shorter, and the certainty of recovering the investment in increasingly more expensive and complex systems is not assured.

ADVANCED MESSAGING IN THE PACIFIC REGION

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As we move into the age of the global marketplace, mobile communications systems are expanding their scope and evolving to provide valuable new advanced messaging services for local, national and international users. Nowhere are these new and exciting services more needed or evident than in the Pacific Region.

COMMUNICATIONS IN THE YEAR 2000

As we look forward to the Year 2000 and a new millennium, and look back five hundred years to Columbus and the discovery of the New World, it is a fitting time to reflect on the past century and its many changes and accomplishments. Clearly there have been significant geopolitical changes -- the rise and fall of Soviet Communism and its iron curtain, the rebirth of Europe and Japan out of the ashes of world wars, unification and discord in the Middle East, and the quiet but constant rise to economic prominence of the Asia Pacific region. There have also been major technical accomplishments -- the invention of the telephone, the automobile, and the computer; the first men in space and on the moon. Inter-related with, and as a result of, these changes and accomplishments was perhaps the greatest landmark of these last hundred years, and that is the commencement of a new global information age. We stand on the brink of a new era of a world economic community where modern communication technology is serving to unite far flung nations into new alliances and relationships.

The recent war in the Middle East is a clear example that this new age has begun. The eyes of the world became fixed on the Gulf as an alliance of nations banded together to turn back Iraq's aggression into Kuwait. The instant television coverage of the war was the most visible sign of our modern global communications arsenal and it served to provide viewers in all parts of the world with immediate information about the war. But a great deal important communication was also taking place behind the scenes, before, during and after the war. First, diplomats and negotiators urgently communicated with each other around the planet in attempts to find a peaceful resolution to the conflict. Later militaries deployed, gathered intelligence and prepared for battle using space age communication technologies. Finally, the end of the war was announced and troops were sent home; then reconstruction efforts began on a massive scale, involving companies and governments from many interested countries. Through each of these stages, hundreds of people from scores of countries were communicating with each other on a global level to deal with a conflict that affected virtually every corner of the planet.

There are of course many less dramatic examples of this new era, which affect our lives and well-being on a daily basis. One of these is the changing behavior of the world business and financial community. The days of isolation and protectionism are fading as countries are now increasingly becoming dependent on external markets. Even the U.S.A., which used to have adequate domestic economic strength to weather most foreign pressures, now finds itself hugely affected by external factors. A decline in foreign demand for certain U.S. products can adversely affect entire industries. If the price of imports rise, we often cannot find domestic substitutes, so our standard of living is affected. If the U.S. stock market begins to slide, the decline can be fueled by investors who now have the luxury to move their money to another more stable exchange halfway around the world, in an instant.

It is a reflection of our emerging global market that business people travel more than in the past, and more easily. Transportation systems are better; foreign countries are more accommodating. Successful growing businesses expand naturally from their local roots to regional, national or even multinational prominence. Economic trade development activities are at an all time high. Many countries are subtly and not-so-subtly promoting themselves as magnets for foreign investment. Clearly, all these things happening in parallel are conspiring to foster the birth and growth of a truly global marketplace.

It is no surprise that international travel is forecast to grow by at least 10% annually through the coming decade as more companies place increasing emphasis on the international markets which they serve. As business travelers begin to spend more and more time on travel, they will seek out and begin to utilize new communication services which allow them to remain in good communication with their home offices and which allow their clients and customers continuous access to them as they move from city to city, or even country to country.

Business people today must strive to be as efficient as possible in the increasingly mobile and fast paced business world. By using all the tools in the modern business arsenal including the telephone, fax, laptop computer, express mail and others, today's

business people can cope with not always being in the right place at the right time, and can stay productive and informed at all times no matter where they are. The business world is increasingly being defined as the world itself as we move into this age of the global marketplace. It is in this rapidly evolving environment that Mtel is developing the world's first Global Messaging Network, designed to provide constant and instantaneous messaging services on an international basis for the business executive on the move.

CHALLENGES OF THE INTERNATIONAL ARENA

The pursuit of a Global Messaging Network is complicated by certain realities that can affect the way the network manifests itself in different countries around the world. Most important is that telecommunications infrastructures vary so widely in different countries. Another important reality is language and cultural differences between countries. Finally, the dissimilar regulatory environments of different countries make a consistency of service offerings in a coordinated time frame a very difficult objective.

Telecommunications development in the past has typically tracked directly with economic prosperity -- as certain countries grew wealthier, their governments and private sectors invested more money in improving the telecommunications infrastructure. The better infrastructure encouraged business growth, which in turn brought greater prosperity. Increased prosperity brought in its wake higher demand for new value-added services. Thus, the most developed countries enhanced their communications capabilities and achieved additional productivity and wealth due to the efficiency gained through improved communications. There are many specific examples of this fact in the Pacific Region, on both sides of the ocean, including the U.S., Japan, Singapore, Canada, Korea, Hong Kong and Taiwan. Many more countries in the region who appreciate this reality are now in the process of making dramatic improvements to their communications infrastructure including Mexico, Malaysia, Thailand and others.

In recent years, however, telecommunications manufacturers and operators from the most developed countries have turned their attention to foreign markets in an effort to increase their exports. The beneficiaries of this new attention will be the less developed countries who offer vast market frontiers and who, out of necessity, are changing their regulatory environments to encourage investment by foreign companies who have technology. Many of the world's government communications monopolies have been deregulated, privatized and/or corporatized in appropriate ways during the last decade, and the deregulation trend is continuing at a rapid pace. As segments of the communications market are opened up, foreign manufacturers and operators are flocking in to fill the void. The result has been the financing and installation of today's most sophisticated technology in countries that, if left to their own market forces, might not have afforded or justified such systems for many years.

The worldwide development of cellular telephone systems provides a clear example. In an effort to sell more switches, transmitters and phones, the major manufacturers from America, Asia and Europe have launched a worldwide competition to promote the licensing and installation of advanced cellular telephone systems. Telephone companies anxious to increase their global operating presence, including the U.S. regional Bell operating companies, have pushed communications ministries to license valuable radio spectrum as fast as possible. Soon it will be possible to speak on portable cellular phones in rural Indonesia, or the outskirts of Kuala Lumpur, or the airport at Beijing, even though it may not be possible to find a convenient wireline telephone in these same places.

Similar forces have contributed to the proliferation of paging systems around the world, and just as cellular has found surprisingly healthy demand as an alternative to wireline telephones, so too can paging systems be used to satisfy communication needs in lesser developed countries.

THE NEW FACE OF PAGING

Paging is often thought of as an adjunct to the ubiquitous touchtone telephone. Fully automated DTMF input of phone numbers has become the paging product of choice in countries with large pager populations. It is easy, automatic, fast and reliable. In other parts of the world, however, paging may manifest itself in very different ways and become more of a one-way message communication system than simply a "call back alert" system.

Where DTMF touchtone phones are not readily available, callers cannot input pages directly and so human operators provide the interface between callers and the paging system. Since callers dictate messages to the operator, they are inclined to dictate longer, more complete messages rather than simply "call back" phone numbers. This is beneficial as the message recipient will not be obliged to make an immediate call back, which could be problematic given the lower density of public telephones in many countries. Alphanumeric messaging is in fact the product of choice in most of South America, Europe and Asia.

Interestingly, alphanumeric messaging is also enjoying renewed interest from U.S. carriers who see the value of sending complete written messages. Previous problems with message input are being solved today with convenient interconnections to E-Mail and PC software packages. Alphanumeric messaging is very logical for international paging networks because it does not demand an immediate call back -- almost a necessity

when the caller and receiver are separated into disparate timezones.

Another new approach to the pulse/DTMF problem is voice recognition technology, which allows callers to communicate verbally with computers. This technology allows a caller to speak a subscriber identification number or security code into a computer and to give the computer other commands, even when the call is placed from a rotary dial telephone set. Obviously, this approach holds great appeal because it reduces expensive human operator involvement and allows more private, automatic operation.

In parallel with the evolution of paging technology to allow more appropriate message input techniques and more complete messaging capability, the pager is also finding logical marriages with other forms of communication. In addition to its more traditional paging services, other services also being introduced by Mtel include "SkyTalk" Voicemail with paging alert, Fax Mailbox with paging alert, and Electronic Mail with paging alert. While these communication services have been available in less convenient forms for many years, they gain significant additional utility when coupled with the pager notification and portable convenience. Voicemail, Fax and E-mail can be high priority, time-sensitive forms of communication and yet, without notification alert, a slow delivery process can often defeat the real value of these technologies. With the integrated Mtel services, subscribers receive instant notification of the existence of messages, whether they are voice, Fax or E-mail, and can then arrange immediate retrieval and response from any touchtone phone no matter where they are.

Mtel sees the need for, and is actively participating in the development of, integrated multi-function devices such as cellular phone/paging receivers, pager/laptop computer devices, and other light-weight, portable, hybrid devices that will provide convenient communication for the travelling business person. Recently, Mtel and AT&T announced the initiation of a joint proposal to market a "wireless E-mail" capability enabling business people on-the-move to receive electronic mail messages via paging receivers directly into a portable AT&T Safari notebook computer.

MESSAGING OPPORTUNITIES IN THE PACIFIC REGION

With almost half of the world's pagers, over 10 million in service nationwide, local paging is becoming a mature industry in the United States. Local paging is used in the US today by over 3% of the country's population. While local paging will continue to grow throughout the 1990's, the recently launched regional and nationwide systems will grow faster, as paging and messaging services are adopted by a new group of users -- travelling business people. International paging is only in its inception of the U.S. but holds great promise for future growth given the geographic breadth of U.S. activities, both in the private and public sectors.

In Japan, local paging needs are well served by NTT and the new common carriers and local paging is used by an even higher percentage of the population than the U.S. Convenient user-friendly nationwide paging on a single frequency, however, is not today available, nor are any international paging service options. Given the propensity of the Japanese to use paging services and their ever expanding economic activities, they are highly likely to be active consumers of national and international paging networks. Mtel is extremely pleased that it has forged an alliance with NTT to market international messaging services to the Japan market and hopes eventually to link up this critical country as a fully functioning member of Mtel's global network.

While the U.S. and Japan together are home for 75% of the world's pager users, there is vast untapped demand in these countries for new advanced messaging services. With the proliferation of voicemail, E-Mail, Faxmail, cellular phones and laptop computers, many interesting and logical new applications for paging and mobile messaging are presenting themselves. As mobile communications marries itself to computer and messaging, new market niches will be found. It is not at all unrealistic to estimate that eventually 25% or more of the population in the most developed countries will be using mobile messaging in one form or another.

Singapore and Hong Kong with their rarified demographics boast over 10% penetration rates for local paging, so there appears to be little room left for growth of traditional local paging. International paging, however, holds great promise for significant growth. If one takes a trip from these city-state nations, by definition one goes out of the country. Mtel anticipates great demand for its international roaming services in these countries and is exceedingly gratified that both countries are now part of Mtel's global messaging network.

Singapore Telecom shared Mtel's vision for an international messaging capability and agreed in 1990 to purchase a 931.9375 MHz paging system using Mtel's proprietary technology. Singapore's international system was recently launched, establishing the first direct linkages between the North America network and Asia. In Hong Kong, a compatible 931 MHz system also utilizing Mtel's proprietary technology was recently licensed and will be launched in mid-1992. That system will be owned and operated by Sky Telecom Services, Ltd., a joint venture between Mtel, Pacific Link Communications, and Singapore Telecom International.

Taiwan has made remarkable progress in recent years with developing its paging industry. The government monopoly for communications of Taiwan,

the DGT, has installed and marketed high quality systems which now serve over 7% of the Taiwanese public. The DGT believes that Taiwan will eventually eclipse Singapore and Hong Kong and claim the world record for highest paging penetration. Taiwan's great success with local paging bodes well for the country's potential with an international service, especially since Taiwan is constantly increasing its role in the regional and world economic community.

On the other end of the paging industry development scale, Indonesia, Brazil, Philippines, Mexico, India, Pakistan, and China, with their sizable populations, have pager penetration rates well below one half of a percent. Clearly in these populous countries, local paging holds great business potential, especially as infrastructures are modernized and income levels grow. Mtel has become convinced of the viability of paging in undeveloped countries because of our participation in a paging venture in Thailand. Given the relatively low density of telephones and income levels, we did not expect paging products to be taken up rapidly. We were pleasantly surprised when our venture placed over 30,000 units into service in the first three months, and hit the 70,000 mark at the end of the first year of operation. Clearly there can be a great deal of demand for paging services in countries which do not fit our conventional demographic profile.

An exciting but unorthodox way of looking at paging technology in lesser developed countries is as a full communication service that provides an alternative to normal telephone or postal mail communication. Given the low density of telephone lines in many countries, paging service providers must modify their approaches and thinking about system design and operation. Even the very basic concept that paging messages are input to the system via telephone should be reassessed. Walk-in message centers, for example, could be used to allow a broader market for mobile messaging services. In any case, the paging system offers a vital communication capability that can serve those people who might not be able to afford or obtain other alternatives, such as basic phone service, in the near future.

In the Pacific Region, there are still excellent revenue opportunities in the local paging area, especially in countries that have lightly developed paging industries such as Indonesia, Mexico, Brazil, China. In the nationwide and international paging segments, the market is virtually untapped and waits to be developed in all countries.

CONSISTENT COMMUNICATIONS FOR AN INCONSISTENT WORLD

Many of the international opportunities in paging and messaging are the direct result of efforts made by companies like Mtel who have a vision about global communication systems and services. Mtel has been pursuing for several years an active campaign to encourage governments around the world to allocate a standard frequency and to take a standard approach to licensing paging systems, thus allowing the interconnection of a worldwide network. Over the years, governments have carved up their spectrum in very different ways, despite the various efforts to maintain some world standards. Without active international lobbying, countries end up adopting dissimilar standards and approaches for their domestic communications systems, and they develop their communications sectors at very different rates. If not influenced, the result is a chaos of inconsistent systems that precludes any chance of truly international operation.

Mtel has a futuristic vision of worldwide personal communications systems. Eventually, Mtel hopes to achieve a system of interconnected mobile messaging networks on a common frequency which allow a subscriber to effortlessly move to another city or country without the need to obtain a new device or special training.

Founded on a "Follow Me" function, Mtel's system permits a subscriber to maintain continuous international coverage simply by dialing into the system and entering certain simple routing commands. The systems are designed with spectrum efficiency and affordability in mind. If a particular user needs coverage only in Hong Kong, he will be able to restrict his service to that level and pay a lower monthly price. If, however, he needs to extend his coverage for a period of time to Singapore, the network and software can accommodate this. If his work or personal life takes him to Singapore for a time, or perhaps to New York, Honolulu or Toronto, the network can follow him and allow his service to continue regardless of his location. The critical thing is that he never has to change his access number so his colleagues, family, boss or clients can always reach him in the same easy way, whether he is at home or halfway around the world.

Global accessibility is a critical component of Mtel's long-term vision for advanced messaging systems. The two basic reasons behind this are simple -- (1) business people are travelling more frequently and more widely, and (2) the larger the market demand, the larger the number of products and services that can be economically developed and supported.

A global paging network can also serve a non-travelling market by providing distributed message input points and low cost telecommunication links between countries. If a subscriber is programmed into the database of a foreign system, callers from that foreign country could conceivably contact him via their local paging network and enjoy all the associated advantages. If VoiceMail, E-mail, Faxmail and other value-added enhancements are linked to the basic paging functions, the power of this communication capability increases dramatically. A caller from Paris could conceivably

deposit a voicemail E-mail message in France for a person in Hong Kong for less than the cost of an direct dial telephone call. Once a global network is widely deployed, it is very possible that this non-travelling market will overshadow the travelling segment in size and traffic volume.

Mtel's vision for a global capability is shared by pioneers in other areas of mobile communication. Cellular carriers are also working to develop compatible systems based on common frequency assignments and computer technology. In addition, other futuristic systems are on the drawing board, such as Motorola's "Iridium" satellite-based cellular phone system which will allow worldwide operation with a single phone set and phone number. As all these various approaches come to fruition, true global networks will result that will allow business travelers to move from country to country while maintaining constant communication.

There are many skeptics who do not yet acknowledge the immense potential of global messaging networks. There were equal numbers of skeptics in the early 1980s who predicted, incorrectly, that nationwide paging would not materialize into a significant business. Clearly paging and messaging services hold an important place in modern communications. There are many hurdles to be overcome in implementing global messaging networks, including regulatory processes, competitive threats and infrastructure limitations, but the potential is too compelling not to aggressively pursue and develop these systems on a truly global level.

These global systems will offer new and powerful mobile communication services to enhance the productivity of business travelers and others, and facilitate the challenging job of conducting business in global market. Through its direct activities and strategic alliances, product development activities and local joint venture partnerships, Mtel has taken a leadership position in the area of international messaging. Mtel is proud to announce the first operational international messaging network linking the United States, Canada, Singapore, Mexico, and soon Hong Kong and other countries. Through its efforts on many fronts, Mtel is striving to expand the frontiers of mobile communication and to develop appropriate tools for the new global information age.

TOWARDS THE NEW AGE OF MOBILE COMMUNICATIONS
--- NEC's MOBILE COMMUNICATIONS PLATFORM ---

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1. ABSTRACT

The concept of the platform for mobile communications network is the one of providing flexible coverage to offer the optimum in personal communications in the 21st century.

2. GENERAL DESCRIPTION

In the communications area, the best optimized infrastructure are being considered in each country for the coming of information society in the 21st century. On the other hand, world wide standardization will also be needed for users' convenience in a borderless age. Under above circumstance, communications itself will be migrated from "machine's communication" to "personal communications" and personal communications will be the major infrastructure which support and substitute the fixed communication networks. This paper will discuss NEC's Mobile Communication Platform (MCP) for the future personal communications based on the area that comprises not only of systems but also terminals.

3. CONCEPT FOR MCP

The objects of personal communications are to communicate anywhere, anytime with anyone. Also, easy operation and user-friendly interface are most important. Many different mobile communication are now operating in the world and many of the users (including operators) may feel inconvenience because of the terminal's incompatibilities and coexistence of many different and independent communication services in a country. For example, users feel frustrated when using mobile communications services by cellular, cordless and satellite systems because of the different systems and terminals. In order to solve such drawbacks, NEC proposes the MCP based on;

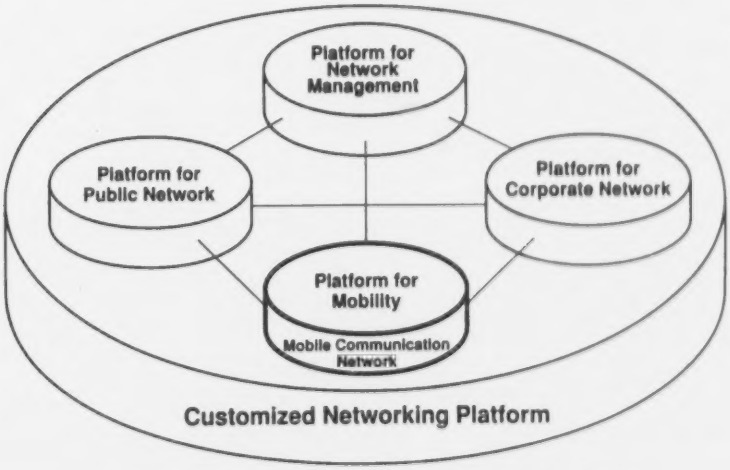

Fig.1 Structure of NEC Customized Networking Platform (CNP)

1) Digitalization technology
2) Effective use of frequency spectrum technology
3) Mobile communications network technology
4) Terminals technology

and NEC's MCP provides the one system integrated different mobile systems.

4. STRUCTURE OF MCP

As shown in Fig.1, the MCP is the one network element on the CNP (Customized Networking Platform) that is a part of NEC's total concept, Computers and Communications (C&C).

The MCP includes not only the radio but the switching, transmission, and network management systems in its network and also interface with other network elements of CNP such as public, management and corporate networks platform. Through this interface, the MCP provides the variable and attractive mobile communication services such as ISDN, video etc.

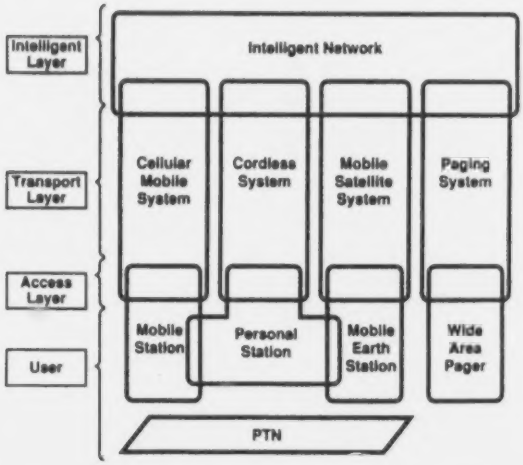

Fig.2 Structure of Mobile Communications Platform

Fig.2 shows the system structure of MCP that is a part of CNP. The user can get the communication services by one common terminal for the cellular, cordless and satellite mobile systems by using a personal identification number and a system approach number.

The NEC Mobile Communications Platform consists of the following four subsystems:

Cellular Mobile System: Provides communication services to high-speed mobile stations (MS), and to personal stations (PS) via MS.

Cordless System: Provides communication services to PS terminals for public, office and home use.

Mobile Satellite System: Provides communication services to low-traffic density mobile earth stations (MES), satellite terminals and to cordless system PS terminals via MES terminals.

Paging System: Provides call/message services to wide-area pagers (WP).

5. BASE STATION FOR MCP

For increasing the system capacity up to the few million within the limited frequency bandwidth, a micro-cell, or pico-cell with a radius of 100 to 500m will be needed. This means that a huge number of the base station should be installed and the investment cost will be increased. To improve the system cost, small, light-weight, low power consumption and low cost base station must be developed.

Fig.3 shows the trend of the relative volume of the base station from '70 to the 21st century. By using VLSI, the base station in the 21st century will be downsized to 1/100 compared with the 70's.

But in addition to the downsizing the base station, the total volume including the approach link and installation materials should be considered. An example of the future integrated MCP base station is shown in Photo 1.

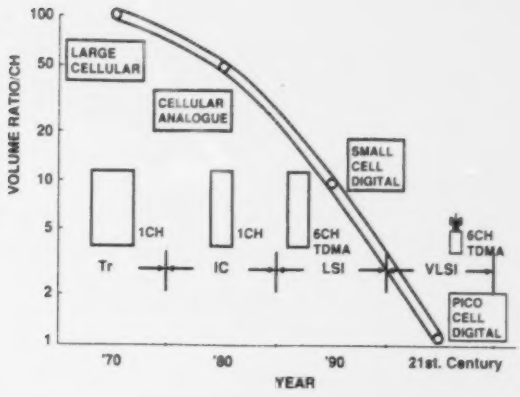

Fig.3 Volume Trend of The Mobile Cellular Base Station

Photo 1 Integrated Mobile Cellular Base Station for MCP

6. MOBILE TERMINALS

The attractive features for users about mobile terminals are their small size, light weight, long battery life and user friendly interface. For decreasing the size and weight, semiconductor techniques such as VLSI and battery technique will be greatly required. Fig. 4 shows the history of downsizing the mobile terminal by the semiconductor's advancement.

Photo 2 shows the latest, small hand held portable analogue telephone terminals. And in the future, by the MCP concept, pocketable and multimedia mobile terminals integrating the voice, data and video services will be developed.

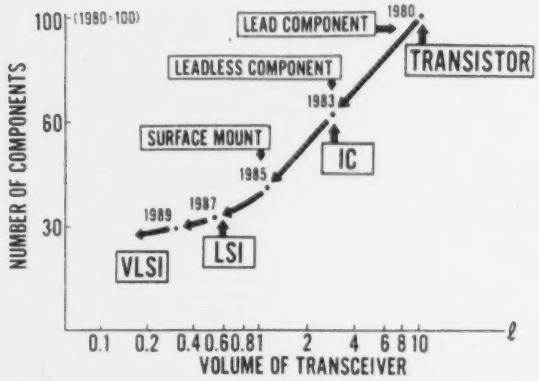

Fig.4 Volume Trend of The Mobile Hand Held Telephone Terminal

812

7. CONCLUSION

NEC's MCP aims to realize the ideal personal communications in the future. And the MCP can be connected to CNP that is the total solution that NEC's Computer and Communication (C&C) concept is striving to provide.

The user can use mobile communication services anytime, anywhere, with anybody, overriding obstacles caused by incompatibilities and system difference.

REQUIREMENTS FOR WIRELESS LOCAL AREA NETWORKS

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ABSTRACT

Wireless In-building Networks (WIN) represent the next major communications frontier for radio applications. The author has performed extensive primary market research to determine the communications needs for the 1990s, focusing on this new market segment. This paper highlights the results from over 1000 corporate and government entities surveyed through different marketing research techniques, with particular emphasis on Local Area Networks. Discussions include: the personal computer trend and local area network growth; the problems with cabling, particularly associated with business moves, adds, or changes; cost effectiveness of wireless LANs; requirements of a wireless local area network for acceptance by the users; the environment best suited for wireless LANs, and specific product requirements.

THE WIRELESS IN-BUILDING VISION

To date, the evolution of wireless communications has been exemplified by the dramatic growth in cellular communications. Cellular has enabled customers to transcend the constraints of fixed telephony in communicating outside of buildings with portable, and now personal, communications devices.

There has been significant interest and publicity regarding wireless in-building communications lately, both for data and voice. Throughout the 1980s, we have seen the development of a significant range of in-building business communications problems that have been caused by changes in the technological, business, and regulatory environments. Because of these developments, buyers of telecommunications and data communications systems increasingly are having to face significant time, cost, and logistical problems associated with the installation, movement, and management of computing and communications equipment in dynamic office environments.

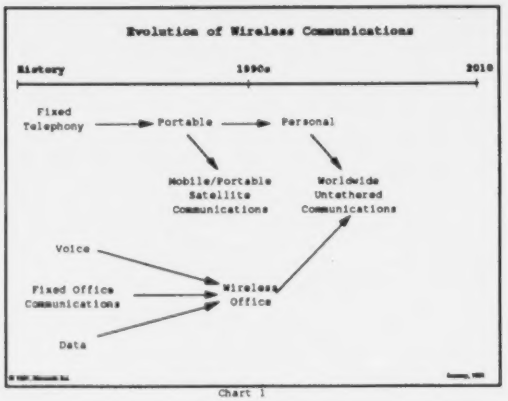

Chart 1

Over the next 20 years, society will witness a significant "wireless evolution" in both personal and professional communications, and change the way we conduct our lives at home, on the road, and at work (See Chart 1). New forms of wireless communications will free us from the "bonds" of wire that today restrict our movements or interaction.

MARKET RESEARCH

Beginning in the mid-late 1980s, a systematic evaluation of the technological and environmental attributes necessary to anticipate and define wireless in-building communications was undertaken. This included a comprehensive marketing needs assessment and research program.

The overriding objective was to anticipate and identify customer needs and trends; that is, "What are the specific needs of various customer groups, and what type of product attributes will satisfy their needs?"

To determine answers to these and a whole host of other questions, a multi-phased marketing research program was conducted. The overall aim of the program was to anticipate and ascertain the customer need, where this need existed currently, what are the market and customer environmental characteristics, and what product characteristics would be needed to provide an optimal wireless solution.

The remainder of this paper describes a higher level overview of the results from these market research phases. This includes an overview of market needs, the problems/difficulties with current cabling methods, and a description of market requirements.

LAN MARKET FACTORS

Personal Computer Explosion

The move from mainframe and central information processing of the 1960s and 1970s provided an opportunity for mini-computers to enter the market. The mini-computer enabled greater computer and applications access by employees.

Throughout the 1980s, the move to more intelligent desktop devices like personal computers were just that--personal. Organizations, in an effort to empower the worker, provided all types of applications, software and hardware to the worker. The decremental costs of technology facilitated the distribution of personal computers. More importantly, projections state that business personal computer growth will continue its aggressive pace (See Chart 2).

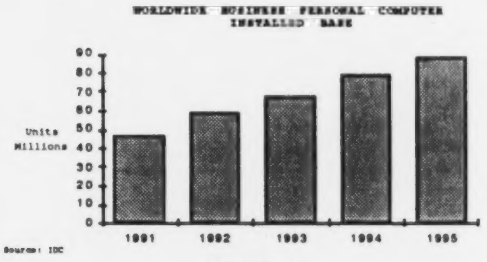

Chart 2

However, the growth of decentralized storage and computing created yet another problem--work groups needed to share information. However, much of this information resided in individual hard disks.

Furthermore, despite the declining costs of personal computers and associated technology, it was and still is considerably expensive to "fully load" the workforce with all of the applications it needs. The ability to share applications became desirable. It was these two trends which highlighted the need for Local Area Networks (LANs).

Information and Resource Sharing

The success of local area network computing was predictable. It started with the basic tenet of sharing resources and/or information. The need to amortize and justify the purchase of expensive resources, such as printers and storage, was an obvious factor which supported LAN growth.

The need for knowledge workers to exchange data was and is imperative. Furthermore, the ability to share applications supported the growth of network computing.

LAN Growth

The sales success of LANs throughout the 1980s has been phenomenal. However, the projected growth throughout the 1990s is equally as impressive (See Chart 3). This can be attributed to not only new installations of LANs, but also to the physical and logical segmentation of LANs as traffic and throughput degradations are observed.

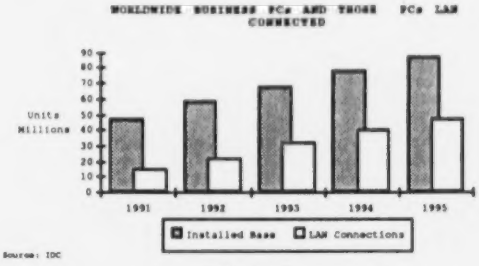

CHART 3

Moves/Adds/Changes And Increasing Mobility

The world economies will continue to develop interdependencies and likewise, global competition. The increasing competitive environment will demand greater worker mobility, changing assignments and reassignments, changing work groups, and mission mobility.

The demand to have information how we want it, when we want it, and where we want it, will be a strategic and competitive weapon. The need to improve efficiency and the growing need for information will accelerate the adoption of wireless communications.

Today's wired network, for all its great strides, remains very restrictive. The cost to deploy and redeploy personnel and work groups is time consuming and expensive. Cabling in today's environment inhibits the ability to attain efficiency and competitive advantages. The next section will highlight some of the author's market research findings.

CABLING PROBLEMS

As each phase of market investigation was conducted, several problems with today's wired networks were uncovered. Whether twisted pair, coax or fiber optic cable, hard wiring for telecommunications and data communications systems within a

building environment is expensive and troublesome to install, maintain, and especially, change. Beneath today's increasingly dense office electronic environment lies a tangled, confusing, virtually unmanageable maze of wiring.

What appeared to be the most consistent response in the focus group research was how quickly the respondents stated the many problems they have with wiring. And, among the majority of respondents, the most favorable solution to this problem was to free themselves of all wiring. The first choice solution would be a wireless system, minimizing the time and effort of implementing a move, add or change.

Moves/Adds/Changes: Cost and Frequency

A major portion of the cost of LANs is the cost of interconnecting them, which experts acknowledge can sometimes exceed the cost of computer hardware and software. Labor and material costs for wiring are almost always significant, and can reach $1000 per node just for copper wire. Coax and optical fiber costs, not surprisingly, are considerably higher.

The news, however, gets even worse when it comes to maintenance. A recent study by the Frost and Sullivan[1] group indicates that LAN moves, adds and changes (MACs) is the third largest cost component of LAN operation. MACs account for almost $2 billion of a $12.2 billion annual LAN maintenance market. Additionally, this $2 billion does not even include the original cost to install cable.

Estimates of the cost to rewire a node range from $200 to $1000 per change. In fact, a survey by KPMG Peat Marwick[2] recently stated that the average relocation cost for just rewiring a LAN node averages $300 per node. But those are just the direct costs; the time to effect the wired change is a significant problem as well. Moves, for example, often take weeks or longer to coordinate in addition to the time to actually make the physical wiring change.

Most of the research respondents were asked what proportion of their company's staff was involved in some kind of a move involving wiring or rewiring. The majority of the respondents, almost 80%, had some type of relocation or addition of personnel over the last year surveyed. And, the respondents' frequency of moves ranged from as few as 20% per year up to as much as 200% annually.

These statistics are corroborated in the KPMG Peat Marwick study, where it is indicated that the average company moves its employees approximately 50% annually. Telecommunications consultant Richard Kuehn states that data terminals are moved as often as 1.5 to 3 times per year. The problems of the actual hard relocation costs, however, are just the beginning. Soft, or hidden costs, further exacerbate the cabling dilemma.

Hidden Costs

Significant problems arise when moves or changes are implemented. There is always the disruption of the workers involved in the move or change, not to mention the loss in productivity.

The problems, however, become much more involved when dealing with whole departments and more complex user equipment. In fact, surveyed firms responded that a relocation (60% of the time) involves the movement of an entire department.

The toll of wait time and down time on productivity varies greatly and is difficult to quantify, but certainly is significant and costly. And in today's increasingly mobile working environment, it is likely to grow. The situation is exacerbated by relocations and additions which require reconstructions, thereby, continuing to add to the effective cost of a move, add, or change.

Another major hidden cost area surfaced regarding the age and complexity of a building. The majority of high-rise office space in large metropolitan areas presents significant problems and expense for tenants trying to install, add or move network wiring.

Buildings more than 30 or 40 years old, with designs and construction that did not consider today's electronic office, poorly accommodate communications wiring. If asbestos insulation exists in the building, as it does even in many pre-health-safety regulated buildings, rewiring costs can take on huge proportions.

The coordination of personnel and the moving of one group out to prepare for the new group moving-in is a very costly and labor intensive ordeal. In some cases, wiring had to be installed, or different cabling may have been needed to accommodate new or different types of users' equipment.

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[1] PC WEEK MAGAZINE, "*Maintenance Costs of LANs keep Soaring*, Source: Frost & Sullivan Inc.

[2] KPMG Peat Marwick Study, January 1991

Cable Is Not Business Friendly

Although office planners, building managers, and network operators are well aware of the problems with wire, the limitations and huge costs of wire haven't generated focused attention outside of this community. The general business world seems to accept wire as inevitable. Perhaps that's because there have been no real alternatives.

Yet, as computing and telecommunications power continues to proliferate and becomes more widely distributed to the "knowledge worker", the problem will increase. Easy, quick, efficient movement of "people assets" within the working environment is also increasingly being recognized as essential to a business' productivity and competitiveness. Wiring severely inhibits that movement.

The research indicated a need for a flexible, compatible, cost effective, yet high-performance wireless alternative to extend and complement, if not replace, the capabilities of wire, cable and fiber for in-building communications networks. More specifically, it is the greater convenience and flexibility that users need. In fact, the aggregate need for flexibility and convenience was found to be two times more beneficial than that of the perceived benefit for cost savings.

When research respondents were asked how they could improve upon their experiences when implementing a move, add or change, many solutions were offered. These solutions ranged from having more compatibility among different vendors' equipment, to providing a better way to organize all the different cabling.

Structured Distribution Systems

A number of firms in the research study had deployed Structured Distribution Systems (SDS). An SDS is a topology which advocates cabling saturation of a desired environment to accommodate all potential personnel movements and reconstructions within that office. SDS requires firms to invest large sums of capital initially on the assumption of not knowing how many telecommunications devices may be employed or where the devices are to be located. Consequently, Structured Distribution Systems usually plan for worst case conditions, meaning that some or much of wiring systems capability may never be utilized.

However, many firms which utilize an SDS also expressed those problems which stress their SDS investment. Some of the most frequently mentioned problems include:

- High equipment addition/relocations, exceeding 40% annually
- Expansion and contraction of their workforce
- Changing technology and business support
- Continued investment and vigilance to maintaining the SDS and its intrinsic advantage
- Continued departmental LAN growth requirements

In short, the latter group of SDS respondents provided some notable requirements for a wireless system. They indicated a wireless system must:

- Extend the capabilities of their SDS system
- Facilitate the inherent advantages of the SDS
- Offer enhanced flexibility to non-serviced SDS portions of their building or occupancy.

The above points indicate that even in SDS environments, there is an opportunity to deploy wireless devices. Wiring--the expense, time, and inflexibility of installing, moving and changing--limits the way companies can productively use networks.

To stay productive, these LANs have to move and change with the workforce they support. Therefore, a wireless offering must be a complementary solution for buildings with an SDS, in bringing wireless flexibility and extensibility to today's networks.

USER REQUIREMENTS: ENVIRONMENT

Several notable conclusions were derived from the marketing research:

Office Friendly

First, research suggests that over 70% of LAN node installations were resident in an office environment (as opposed to factories and warehouses). Therefore, as an office oriented offering, a wireless system would have to be, by definition, office friendly.

A traditional office is composed of hard offices with opening and closing doors, furniture and personnel movement, cubicles, conference rooms, and walls of varying thickness and

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substance. Therefore, a wireless system must continually adapt to different and changing conditions, and office layouts.

Optimized Service Area

The second wireless in-building need expressed by the office market is the manageability and reuse of any potential system. Unlike the signal propagation characteristics of many lower frequency radio products, LAN administrators desired the ability to control, or more aptly, contain, the coverage of a potential wireless system. The reasons were twofold:

- LAN managers wanted the ability to add different services to a new group of users. In fact, these new users may very well be physically adjacent to another system, wireless or wired.
- These same managers wanted the flexibility to connect a new or existing user group to either a backbone or to create a stand alone LAN.

LAN Workgroup Sizes

Respondents were asked as to where a wireless offering might be first installed. The market research indicated that approximately 70% of the installations would contain less than 30 users (See Chart 4). Furthermore, the average LAN appeared to be in the 12-15 node range. This is further corroborated by the KPMG Peat Marwick study which found that the average LAN size is about 15 users per LAN.

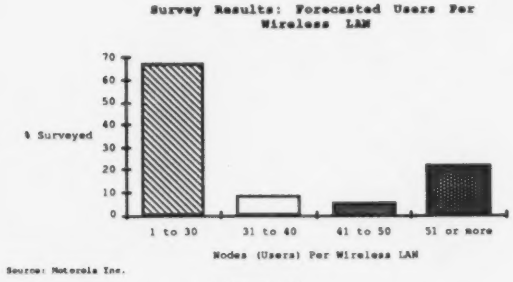

Chart 4

Furthermore, there must be an inherent flexibility to grow the wireless service area. That ability, to either incrementally add systems whether on the wired backbone or in a stand alone wireless configuration, must accommodate scalability within an organization.

It is interesting to note that these figures are consistent with good LAN administration practices for purposes of maintaining high throughput and fault isolation. As LANs become larger and traffic more intensive, there is a natural inclination to begin segmenting LANs into more logical and defined user areas/groups.

Coverage Area

To satisfy the majority of requirements, it has been determined that approximately 70% of LANs would be deployed in areas less than 5000 sq. ft. (See Chart 5).

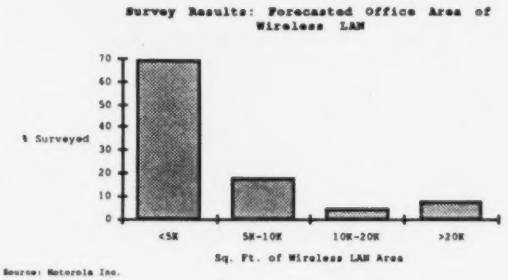

Chart 5

This determination must take into consideration the fairly dense environment, made up of cubicles and apportioned hallway space. The market investigations indicated that a wireless offering must accommodate, at the least, 150 sq. ft. per user. This is equivalent to 32 users/system in a 5,000 sq. ft. area.

PRODUCT REQUIREMENTS: END USER REACTION

Transparency, Compatibility, and Performance

To justify the investment in a wireless system to end-users, a wireless offering would have to provide reliable performance, as well as be practical and cost effective. The market research indicated that the ideal system should be:

- Easy both to install and move, preferably by the user.
- Able to coexist with both existing wire and cable, as well as with future optical fiber.
- Easy to operate, virtually transparent to the user.
- Almost universally applicable, suitable to replace any LAN cable or wire, in any office environment.
- Powerful, performing at multi-megabit per-second speeds.

- Secure, absolutely reliable, and cost effective.

A wireless system is a "media replacement" and therefore must be totally transparent. If the customer is to enjoy the attributes of wireless, the respondents indicated that the wireless implementation must not require the user to change the way he operates or interfaces with his personal computer.

Also, a wireless offering must provide true compatibility. The wireless connection must be compatible with standards-based components such as operating systems and applications, LAN cards and other devices, as well as LAN wire that is already in place.

Security and Reliability

The market mandates that a wireless product offering be absolutely secure and reliable. Security was a requirement across several dimensions. To provide sufficient data security, a wireless system should first prevent the effective capture of data by a receiver outside of the wireless system, and second, prevent capture of the data by unauthorized wireless hardware within the system. A wireless product must be secure from eavesdropping, either accidental or intentional.

Reliability was another important attribute. Users require absolute reliability. That is, users wanted a guaranteed packet delivery from the entry/exit wireline points--and they wanted it at least as error free as their current cabled environment.

Cost Effective

Finally, most businesses will place any capital or expense under rigorous financial analysis. As such, the acceptance of a new technology/application must pass the payback hurdle for that business. Therefore, demonstrable payback justification is needed to facilitate an organization's evaluation of any potential wireless offering.

TECHNOLOGY ALTERNATIVES IN MEETING CUSTOMER REQUIREMENTS

IR and Spread Spectrum Technologies Lack Performance

Developing the ideal system, obviously, is not a trivial problem to solve, and is the reason why a perfect system hadn't appeared on the market prior to 1991. There are three basic technologies which characterize the wireless LANs currently available. Several wireless network products are based on two of the three wireless LAN technologies: either infra-red or spread spectrum. But each of these two technologies suffers from limited performance and operational problems inherent to the technologies on which they're based.

Infrared (IR) systems use a part of the electromagnetic spectrum just below visible light as a transmission medium. IR, being light, travels in a straight, or line-of-sight path. It is blocked by opaque objects and reflects well only off hard, mirror-like surfaces. This factor stands as a serious obstacle to IR systems for applications other than in open working environments.

A more promising candidate might be one of several systems operating just below 900 MHz, at the upper end of the UHF band used by television, FM radio and cellular telephones. Because of the crowded, low availability of bandwidth in this frequency range, these systems use spread-spectrum technology. This technology, developed by the U.S. military, uses a combination of several small, narrow bands within a general region of this band as carrier frequencies.

Although this technology helps to address important interference and security considerations, it can't solve the fundamental problem of available bandwidth. (In radio transmission, the wider the bandwidth or available frequencies on which to encode data, the higher the achievable total data rate.) Even with multiple frequencies, the total bandwidth available to spread-spectrum systems assigned by the FCC is inadequate to support more than about 2 Mbps. Simply put, this area of the RF spectrum is already taken up and accounted for by other uses.

Another important issue in this UHF environment is that RF energy at these frequencies tends to propagate through and around obstacles, reaching beyond the confines of the network that it is serving. That property makes this RF band suitable for receiving commercial broadcast signals from distant stations through the walls of buildings to receivers inside. It also makes it suitable for mobile cellular telephones. But it can't be contained within the confines of the microcell described earlier. And that limits spectrum reuse and overall network capacity requirements absolutely essential in a viable wireless network communications system.

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Current UHF spread spectrum wireless in-building communications systems, then, suffer from critical bandwidth and spectrum reuse shortcomings that seem likely to prevent them from expanding beyond limited applications.

The 18 to 19 GHz Radio Band: An Ideal Choice for Wireless In-Building Microcellular Networks

The 18 GHz region of the electromagnetic spectrum, above the kilohertz and megahertz radio bands, yet below the extremely high frequencies of the infrared band, offers two very compelling advantages. Specifically, the 18 to 19GHz portion of this band fulfills the key requirements of spectrum reuse and bandwidth availability that eliminates most other frequency choices from serious consideration.

Propagation Properties Right for Both Microcell Coverage and Confinement

The first major advantage of the 18 GHz band is its excellent propagation characteristics for a microcellular network. Indeed, the behavior and properties of these higher frequencies that are disadvantages for traditional long-range broadcast applications become critical advantages for wireless in-building network applications. Propagation characteristics of 18 GHz radio waves make them well-suited to diffuse thoroughly through a network microcell using a minimum transmitted power, yet remain confined so that the same frequencies can be reused by another system within as little as 120 feet or so, or on the other side of a dense, continuous barrier such as a cement floor. Typical microcells might encompass, for example, a level or floor, or portions of a floor, in a standard office building.

As one might expect, 18 GHz radio waves exhibit a blend of the characteristics of both IR light above them, and UHF frequencies below them. For example, like light, 18 GHz waves are blocked and reflected by large structures such as concrete and steel. The 18 GHz waves reflecting back and forth in an area defined by concrete floors, ceilings, and walls, result in thorough radio coverage. The 18 GHz signals also refract like light, penetrating tiny holes and cracks such as closed doors to diffuse and spread through the space beyond. What little radio signal that might escape the microcell would be rapidly dissipated.

On the other hand, like radio and unlike light, 18 GHz signals still can pass through less dense materials such as drywall and interior office separators and, combined with their reflectivity, are not subject to "line-of-sight" limitations. They can also be modulated to carry information just as traditional lower frequency radio signals are.

Also, unlike lower frequency radio, 18 GHz radio is of a high enough frequency that not only office equipment, but even high energy factory equipment and processes don't interfere with it. Likewise, with its high frequency and low required transmitted power, the 18 GHz signals themselves from such a system would not interfere with other electronic systems or equipment.

And, finally, since antenna size and design are largely a function of wavelength, which decreases as frequency increases, the antennas for the 16-mm wavelengths of an 18 GHz radio system would be relatively small and compact.

Plenty Of Bandwidth In An Otherwise Crowded Spectrum

The second major advantage of 18 GHz radio is its available bandwidth. Few other areas of the electromagnetic spectrum are as interference-free, clear and available as this band, certainly not the VHF and UHF bands, which must accommodate television, FM radio, cellular telephone, baby monitors and more.

The reason for this clear band is largely that these higher frequencies have been difficult to work with. The particular technical properties of 18 GHz frequencies and the expense, size, and complexity of the equipment to use them, have prevented them from being an attractive option for many commercial applications. As a result, the military has been the primary developer and user of the 15- to 300-GHz band, and the few commercial uses that have emerged (weather, aircraft and police radar, point-to-point telecom transmission, etc.) use expensive technology pioneered by military-funded research.

For any wireless in-building communications technology to be a legitimate complement to wire, data speeds must be in the multi-megabit per-second range. Achieving these speeds over an in-building radio system, however, had never been done until Motorola recently developed the Altair (R) wireless Ethernet network. Such an application required the creation of new, improved performance data handling and signal processing hardware and software, as well as a radio antenna system that could transmit and capture these data speeds

on 18 GHz frequencies in an in-building environment.

SUMMARY

The numerous problems with wiring will become even more acute in the office of the 1990s. This environment will be characterized by:

- The proliferation of decentralized computing resources.
- Increased number of telephones and personal computers as an outgrowth of a country's economic shift toward service industries.

As the penetration of personal computers nears a one-to-one relationship with phones in the office workplace, the limitations of separate voice and data networks will become even more evident. If these problems are not addressed, an organization's flexibility in redeploying "people assets" and ultimately competitiveness will be seriously hindered.

The time it takes to move/add/change equipment and reconfigure communications wires will be the limiting factor in rapidly reorganizing workgroups and responding to new assignments. Wireless LANs will become an attractive solution in the office of the 1990s, interconnecting personal computers and offering data communications capabilities without the need for elaborate cabling methodologies.

The obvious and inherent flexibility offered by wireless LANs is the obvious primary benefit. However, the ability to retrieve that investment, never retrievable until now, clearly presents a significant economical benefit.

21ST CENTURY SATELLITE OPTIONS FOR THE ASIA-PACIFIC: A COOPERATIVE U.S.-JAPANESE STUDY

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ABSTRACT

A year long study carried out at the University of Colorado has identified a range of new satellite system options to aid the Asia-Pacific region. These studies, supported by grants from NASA, propose a range of exciting new satellite projects for the Asia-Pacific region.These projects include: (a) A series of lightsat projects to aid education, health, weather alert, rescue operations and telecommunications among Asia-Pacific island countries. (b) A joint U.S.-Japanese operational prototypes satellite that could operate at multi-gigabit/sec speed. (The next step beyond ACTS and ETS-VI). (c) New ways to use GPS packages on low orbit satellites in the Asia-Pacific Region to monitor global warming. (d) New developments in USAT (Ultra Small Aperture Terminal) technology to aid rural and remote services, and (e) Conceptual studies for 21st century satellite systems that have high performance and reliability with minimum transmission delay and easy interconnection into terrestrial systems. The results of these "unofficial" studies will nevertheless be presented to the United States' National Aeronautics and Space Administration (NASA), the Japanese Ministry of Posts and Telecommunications and its National Space Development Agency (NASDA), and the U.S.-Japan Committee to determine their possible feasibility for implementation.

1. INTRODUCTION

The Asia-Pacific region is today at the core of the world economy and in many ways the hallmark of our global future. It is difficult to define the region in a way that is universally accepted. This is because the region has so many subregional elements with many of these at different levels of economic, social and cultural development. The Pacific Rim countries (**See Table I**), now include some 30 nations and are dramatically different in culture, geographic size and economic product from the small Pacific island countries. Although these island countries (**See Table 2**) also number nearly thirty, their population and economic size are two orders of magnitude less. The difference do not end here. The Asian countries are quite different from those of the Western Hemisphere and so forth. Certain facts, however, stand out. The North America countries of the U.S., Canada and Mexico on one side of the Pacific and Japan on the other are the key economic drivers of the region and to some extent the entire world. Japan and her newly industrialized neighbors on the Asian continent serve as economic magnets. These Asian countries pull a great amount of economic trade to their side of the Pacific. Conversely the U.S. and her immediate neighbors on the opposite shore of the Pacific create an opposite attraction. It is thus not an exaggeration to suggest that Japan and the U.S. are the economic motors that drive the vast and rapidly growing Asia-Pacific region and that the key elements of this economic growth are high technology, improved, high capacity communications networks, and expanding trade.

Certainly, the key machinery that makes this vast economic region a reality is not fleets of planes, or ships, or stock markets, or banks, but rather the ever increasing information and telecommunications systems that enables and empowers all these services and more. The contention of this study is that the communications systems of the region is the core element of the Asia-Pacific region as we know it today. In short the Asia-Pacific region as an economic, social and cultural presence would not continue to exist without these electronic systems and their ongoing development and growth. While advanced telecommunications systems are clearly important to other regions such as Europe, the great differences in time and place and culture make electronic communications and information technology especially crucial to the Pacific region.

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TABLE 1:
COUNTRIES OF THE PACIFIC RIM

AUSTRALIA
CANADA
CENTRAL AMERICA
- COSTA RICA
- EL SALVADOR
- SINGAPORE
- GUATEMALA
- HONDURAS
- NICARAGUA
- PANAMA

CHILE
CHINA
COLUMBIA
ECUADOR
HONG KONG
JAPAN
MEXICO
INDONESIA
KAMPUCHEA
KOREA, REPUBLIC OF
KOREA, PEOPLES REP. OF
MALAYSIA
NEW ZEALAND
PERU
PHILIPPINES
SINGAPORE
TAIWAN
THAILAND
UNITED STATES
USSR
VIETNAM

TABLE 2:
THE PACIFIC ISLANDS*

AMERICAN SAMOA (U.S.)
COOK ISLANDS
EASTER ISLAND (CHILE)
FEDERATED STATES OF MICRONESIA
FIJI
FRENCH POLYNESIA (FRANCE)
GALAPALOS ISLAND (ECUADOR)
GUAM (U.S.)
HAWAII (U.S.)
KIRIBATI (FORMERLY GILBERT ISLANDS)
MARIANA ISLANDS
MARSHALL ISLANDS
NAURU
NEW CALEDONIA (FRANCE)
NIUE (NEW ZEALAND)
NORFOLK IS. (AUSTRALIA)
NORTHERN MARIANA ISLANDS (U.S.)
PALAU
PAPUA NEW GUINEA
PITCAIRN ISLAND(U.K.)
SOLOMON ISLANDS
TOKELAU
TONGA
TUVALU
VANUATU
WALLIS AND FUTUNA (FRANCE)
WESTERN SAMOA

*NOTE: Territorial status is indicated in parentheses. Protectorates and trusteeships, however, are not shown. Any corrections or updates to the above chart would be appreciated.

COUNTRIES WITH TERRITORIES
IN THE ASIA-PACIFIC REGION

FRANCE
UNITED KINGDOM

In this study the Asia-Pacific region is defined as covering the "entire" Pacific Rim and all island countries protectorates as well. Although the full scale study undertaken under NASA Grant (NAGW-1105) examines a much broader range of issues, this paper focuses on specific potential satellite projects that might enhance Asia-Pacific cooperation in the five following areas:

(a) Lightsat projects to aid education, health,weather alert, rescue operations and telecommunications among Asia-Pacific island countries.

(b) A joint U.S.-Japanese operational prototypes satellite that could operate a multi-gigabit/sec speed.

(c) New ways to use GPS packages on low orbit satellites in the Asia-Pacific region to monitor global warming.

(d) New developments in USAT (Ultra Small Aperture Terminal) technology to aid rural and remote services.

(e) Conceptual studies for 21st century satellite systems that have high performance and reliability with minimum transmission delay and easy interconnection into terrestrial systems.

Ultimately the purpose of this study is to examine how the development of new telecommunications technology and innovative new patterns of cooperation within the Asia-Pacific region can contribute to the overall economic, social and political development of the region and perhaps ultimately the entire world. Although the scope of this study is the entire region it clearly gives special focus to U.S.-Japanese cooperation and liaison.

2. LIGHTSAT SYSTEM CONCEPTS FOR ASIA-PACIFIC REGION

2.1 The Appropriate Role for Lighsats

The attractiveness of small, inexpensive satellite communication system for the Asia-Pacific region has been recognized in U.S., Japanese, and other design studies for some time. This is not to say that established satellite systems with advanced high capacity satellites such as the INTELSAT VA, VI, and VII's will not continue in the future to provide the bulk of satellite services. It only suggests that certain niche services especially for rural and remote satellite services and for non-commercial applications like health and education could be met by lightsats. Thus in parallel with the development of large satellite systems, there has been intensive new research and development with regard to light satellites. Small satellite systems are being considered for many different types of purposes, and the payload of these various lightsats range from several kg to 100 kg, with others as much as 300 kgs or more for some specific missions. The missions of such small satellites include communications, navigation, earth observations and engineering test. Lightsats are certainly not a panacea. There are severe limitation in both mass and available power. Clearly, only rather limited missions can be effectively taken aboard small satellites.

The are nonetheless some key reasons why the small satellite has been highlighted recently as an important new option. These include advancements in micro-electronics development, ring gyro laser orientation and positioning, low costs for microsat launch services, fast turnaround time, low total project cost, multiple discrete satellites which can exactly match satellite capacity to traffic demand, and even the psychological reason of having one's "own" satellite[1].

The small satellite can be very attractive for the developing country especially in terms of its low cost. The low cost of the lightsat does not necessarily mean low cost communication per channel but it does mean low total project cost. To date many commercial satellite communications systems have been proposed, particularly with regard to mobile satellite services. Some envision continuous voice service while others would use store and forward data services. Some would use only one satellite such as the initial Satellife Project and some would deploy a constellation of as many as 77 satellites. Some would use low-orbit circular polar configurations and some would be geosynchronous.[2]

Thus, it is clear that there are a great many viewpoints concerning the small communications satellite. Lightsats can thus be considered to be low circular, medium elliptical, or geosynchronous in orbit, range from 5 to 500 kilograms, and be for commercial or social service purposes and can provide one or more of the above noted services although communications is still the most likely application. The small satellite system for the Asia-Pacific region reported upon here is only one of the concepts examined in the larger NASA study. It was selected from among the other concepts because it seemed quite viable for sequential implementation within the region starting with the Federated States of Micronesia (FSM). It can be accomplished at medium to low cost and with reasonable speed of implementation. In short it seems the one most likely to be recommended for a Joint U.S.-Japan Cooperation project.

TABLE 3: LIGHTSAT OPTIONS

Orbit Type	LEO		EEO		GEO
Service Period	Intermittent	Continuous	Continuous	Continuous	Continuous
Sat. Size	Small	Small	Small	Large	Small
Number of Sat.	2-3	Several tens	3-4 or 10-12#	3-4 or 10-12#	2
Technical Performance	Data (2.4kb/s)*	Voice Data (16kb/s)*	Voice Data (9.6kb/s)*	Voice Data (32kb/s)*	Ku-Band 150ch 64kb/s VSAT
Lifetime	3 years*	3years*	3years*	3years*	15years*
Cost	Low	High	Low	High	Low
Remarks	Store & Forward Long Response Time	Short Transmission Delay Realtime	Transmission Delay Realtime	Transmission Delay Realtime Earth Station Ant. Tracking Facilities	Transmission Delay FSM DOMSAT Total Cost $160M Redundant Transponders

* A typical value is shown.
\# 3-4 would be for highly elliptical orbits and 10-12 would be for medium orbits (e.g. 200 km apogee).

As noted above there are at least three orbits appropriate for lightsats. For ease of comparison we can refer to low Earth orbit (LEO), elliptical Earth orbit (EEO) and geostationary orbit (GEO). The satellite orbit itself is not directly tied to the concept of small satellite. These orbits have pros and cons as shown in **Table 3**. These can be briefly summarized as follows. LEO has the advantages of small propagation distance, short propagation delay, low-cost and simple satellites, and small, low cost ground antennas. The disadvantages, however, are short visible time of pass, the need for many satellites to establish continuous service, and the likelihood that low gain, squinted omni antennas will provide limited capacity. EEO has an advantage of long visible time and a smaller number of satellites for continuous visibility. But its disadvantages are longer propagation delay, much fuel required usually, and the likelihood that tracking systems will be necessary. GEO has the advantage of no tracking requirement of the earth station, a minimum number of satellites, but the disadvantages are long propagation delay and higher cost of launching.

There perhaps two basic points of view with respect to the use of lightsats for a reasonable full service satellite telecommunication system. These are the international / regional type system and the domestic network. The international / regional service would likely best be accommodated by the LEO and/or EEO satellites where large numbers of lightsats would give broad coverage. The much more limited coverage of a domestic service on the other hand will often best be accommodated by a small GEO satellite. The following section illustrates both approaches.

2.2 Creating A New Data Network in the Asia-Pacific Region Using Lightsats

In order to cover the entire Asia-Pacific region a configuration of small satellites would be launched into LEO or EEO orbits. These satellites could be deployed so as to create a data network whereby the Pacific Rim countries and all the islands would have the ability to request information from data sources throughout the region or even around the world. Examples of the type of information that could be obtained might

include disease control information, agricultural research findings, economic forecasts, medical procedure information, and the latest advances in meteorological research. This system could have access to hospitals, for example, in the advanced countries and experts could give diagnostic, procedural, or pathology findings or advice to the requesting personnel. This system, however, would require very short turn around times for informational requests in order to save lives or to support urgent operational programs.

To keep the service response time rapid and to accommodate many users in order to provide enough revenues, the system would need a large number of satellite and large memory capacity. This in turn impacts the size of satellite, its complexity, and thus increases the total system investment cost. Instead, an alternative satellite system concept seems more appropriate. This would be a smaller scale non-profit communication system wherein a much longer turnaround or response time can be allowed but then only a smaller number of users can be considered. One might restrict users to universities, hospitals and/or medical research institutions. This means we can use very small LEO lightsats, and thus decrease the total cost to a very small amount such as $ 2-4 million. However, if it were decided to opt for a lightsat system that could be used to save lives, then near real time operation will be required which would suggest the elliptical orbit approach. These two options are discussed briefly below.

(i)LEO orbiting satellite system: Giving the small number of users and relatively long turnaround or response time, it is possible to design a quite inexpensive small LEO satellite system. If one proceeds with two LEO satellites of the so-called MACSAT design[3], it is possible to provide 2-6 hours write-to-read time which would support a great deal of information transfer. Each MACSAT would have 1.2 Mbytes on-board memory. Its 2.4 kb/s data transmission rate would provide 64 kbytes data transmission per orbital pass assuming the orbital configuration (e.g. 500 kilometer circular orbit) shown in Table 3. In the MACSAT system, users must share the 64 kbytes of data that can be transmitted per pass.However, the lightsat system considered here would presumably be restricted to a reasonable number of users. Therefore, there might be typically one, two, or three users per satellite pass.

(ii)EEO orbiting satellite system: The requirement of real time data transmission would require the use of one GEO satellite, three to twelve EEO satellites (depending upon the apogee of the elliptical orbit) or many LEO satellite system. The many LEO satellite system would be expensive. GEO system is also still expensive. There are, however, several systems using EEO. The most extreme of these is the highly elliptical orbit (HEO) satellite system of the U.S.S.R. known as Molniya. This system has been operational for more than 25 years, although recent Molniya launches have been placed into geosynchronous orbit. Recently, ESA has proposed the ARCHIMEDES (Advanced Research in Communications Highly Inclined orbits for Mobile applications and other Experiments and Demonstrations using European Satellites). Germany has proposed the LOOPUS (Geostationary Loops in Orbit Occupied Permanently by Unstationary Satellites). France has proposed the SYCOMORES system. These operating or proposed systems are used for the satellite communication in the high latitude area and would use relatively large satellites. On the contrary, the Phase III amateur satellite, OSCAR-13, is a small satellite whose weight is 142 kg. The propagation distance of the HEO satellite system is approximately the same as GEO satellite, around 38,000 km. Therefore, with this type of orbit a large EIRP is required of the satellite as well as a high gain antenna on the ground. It is still possible to design an inexpensive satellite system if the transmission rate is low, for example less than 9.6 kb/s. Another approach is to adopt the concept which is proposed with the Ellipsat system whereby an elliptical orbit with approximately a 2000 kilometer apogee is used in a configuration of 10 to 12 lightsats to cover a region rather than the entire world. In terms of satellite costs, launch costs, and earth station antennas, an information network for the Asia-Pacific region could be designed for less cost that a geosynchronous satellite system.

2.3 Small GEO Satellite--Domestic Communication System

A domestic satellite (DOMSAT) communications system for the Federated States of Micronesia (FSM) represents a good example of a small GEO satellite application. FSM was selected for this example because of the following factors: (i) The satellite communication is the optimum method to link such a configuration of islands. (ii) A small geostationary satellite is a plausible way to meet their domestic communication needs and to optimize the total cost. (iii) The FSM has a strong wish to build their own domestic communication system. (iv) An agreement to study this system will be obtained from the telecommunications authority of FSM.

According to the rough design of the system, the satellite size might be 90-130 kg, with 2 transponders on-board (one operational and another partially operational / partially redundant). A representation of the satellite and its coverage of FSM is provided in **Figure l.** One transponder could perhaps accommodate 150 64 kb/s circuits using 2.4 meter VSATs in the Ku-band with the bit error rate of $1x10^{-7}$ and link margin of more than 6 dB. If one were to use 16 kilobit /second voice, then a single satellite using one and a half transponder could support the equivalent of 900 voice channels. One could opt for one or two satellites with the second satellite to be launched in case of the primary satellite's failure. If the second satellite were indeed launched then it could be used to transmit four to six TV channels of 3 megabits /second compressed video. A very rough cost estimation shows that the total cost for the complete system could be approximately 150 to 160 Million Dollars including two satellites, their launches, insurance and ground facilities including a control station, a hub station, VSATs and terminal facilities such as telephones, faxs, tv sets, etc. The lowest cost, non-redundant start-up lightsat system would be perhaps $40 to $50 million..

3. HIGH CAPACITY SATELLITE PROJECT

This section addresses new 21st Century, high technology, high performance satellite communication systems that attempt to extend the state of the art beyond ACTS and the ETS-VI experimental satellite systems of the U.S. and Japan respectively. Unlike the lightsat systems considered in the previous section the attempt here to explore super high rate multi-gigabits / second transmission rates for "intelligent" satellite systems of the next century.

3.1 Needs of High Data Rate Transmission Satellite Communication System

In the ACTS (Advanced Communications Technology Satellite) project, a high data rate means 220 Mb/s to perhaps 622 Mb/s or SONET rate. The 1 Gb/s rate of data transmission for a single data link is for the Advanced Asia Pacific Telecommunications Satellite (AAPTS) somewhat arbitrary. but is considered a good benchmark to support supercomputer interconnection, 3-D Scientific Visualization, 3-D HDTV, desk-top video and other 21st century applications. Such a high speed data transmission can expand the application fields to a great extent. The need for high data rate transmission will at least include the following (See Reference 4):

-The nature of modern science and the types of scientific problems being addresses today demand unparalleled dynamic connectivity and major increases in bandwidth. There are growing needs for scientific high data rate transmission to support telescience, telecollaboration and remote access to proliferating, distributed databases. For example, the need to understand and monitor global change will likely generate 7000 terabytes of data over the next decade. This is an amount of information many times the total content of the U.S. Library of Congress.

-Simultaneous the remote database access is limited today by the ability of telecommunications services. There is a need for improved connectivity and increased bandwidth to provide remote users with access to central supercomputer capabilities. Enhanced X-window capability will reinforce this trend.

-There is a growing mismatch between the capability of telecommunications services actually available to users and users' needs and technical capabilities.

-Although the fiber optics technology is overtaking satellite capabilities in many areas, satellites still have unique areas of opportunity to supplement terrestrial fiber. Furthermore in certain areas like broadcasting, mobile services, and superlarge networks with extensive nodes, satellites still retain a significant edge.

-In the U.S., since the deregulation of telecommunications, a serious connectivity problem has developed due to lagging standards and the difficulty of orchestrating cooperation between the regional telephone companies and the hundreds of small independent companies.

The ACTS satellite will demonstrate very high data rate transmission[5]. The applications of this ??? on the ACTS include:

-NREN (National Research and Education Network): NREN is one of four HPCC (High Performance Computing and Communication Network) Program components. The goal of the NREN is to put in place a high speed (up to 1-3 Gb/s) fiber backbone for a research network that will provide a distributed computing capability linking the U.S. government, industry, and the higher education community. ACTS may have unique capabilities to extend the resources of the terrestrial fiber network to off-network locations.

-Supercomputing Applications: File transfer at rates up to 800 Mb/s requires wide-band networks. This capability will allow remote supercomputer sites to be linked with the main fiber backbone, and expanding the wide-band network to less populated areas.

-Remote Medical Imaging: As one of the supercomputer network applications, the remote medical imaging data flow from the CAT (Computerized Axial Tomography) Scan to supercomputer, to animation device, and to medical workstation.

-HDTV (High Definition TV) Applications: The HDTV technology can be applied to network/cable television, commercial/industry, graphic arts applications, medical and scientific applications.

-Scientific Applications: The above-mentioned NREN will support scientific visualization, X-window multiple database access, etc.

In addition to the above mentioned applications, the high speed data network using the AAPTS satellite in the Asia-Pacific region will have the following specific features:

-The 1 Gb/s transmission corresponds to 15,000 equivalent 64 kilobits/second voice circuits. This is many times the present communication capacity of many countries in the Asia-Pacific region. Therefore, the full 1 Gb/s rate capability would apply to only a limited number of high traffic areas in the region such as Los Angeles, Tokyo, Osaka, San Francisco, San Diego, Sydney, Taipei, Hong Kong, Mexico City, Singapore, Djakarta, Seoul and then perhaps reduced or partial rates for Vancouver, Peking, Kuala Lumpur, Manila, Auckland and so forth. Certainly to link such countries by significantly higher data rates will contribute toward accelerating the further development in the region tremendously. Every country in the region could still have the opportunity to plug into this multi-gigabit satellite at some appropriate data rate using the regional beam.

-The service area is very large and dispersed in the Pacific region. Then the network completely covered by fiber cables will be unable to be applied for economic reason. The satellite and/or hybrid satellite and fiber technology are very appropriate in this region.

-However, the need of such super-high data rate is still not well market justified especially in the commercial business field. Thus the development of such a high performance satellite has a technology development aspect.

3.2 Design of Experimental Communications Technology Satellite

An advanced communications satellite system envisioned in this study would provide not only 1 Gb/s data rate transmission links to selected cities in Asia-Pacific countries, but would also have a multi-gigabit/second total capacity. It is important, however, to design the satellite as a practical operational prototype that could be placed into commercial service after initial tests and demonstrations are complete. A facility of this complexity, cost, and program dimension is too grand of undertaking for simply experimental purposes. By combining U.S. and Japanese resources and obtaining a commitment from commercial sources such as INTELSAT, NTT, KDD, AT&T and others a strategy of experimental satellite migrating to operational service could potentially be devised. The idea is thus to seek aggressively an important new and challenging technology development without undercutting the viability of operational use and recouping of an investment that would at least be many hundreds of millions of dollars. The basic concept of this study option is provided in **Figure 2.** The key issues to be considered with respect to this study option are enumerated below. It should be noted that other approaches are being addressed in the full study under the NASA grant and that these include a high data rate satellite that includes the feature of bit by bit processing and on-board signalling as well as other even more advanced concepts which are discussed in Section 4.

(i)Service Area vs. Number of Satellites: The Asia Pacific region is located over some 200 degrees of longitude: from 80 degree East to 80 degree West. This means that any one satellite can not cover the whole region. In addition, the higher frequency band is assumed in order to achieve high data rate transmission. The higher frequency band communication link, however, suffers much more rain attenuation. Since, low elevation angles are not desirable a two satellite system with intersatellite link is one possible approach. The inter-satellite link will be useful to avoid rain attenuation in the double hopfeeder link it slightly decreases propagation time. Assuming that the two satellites are located at 150 degree East and 120 degree West, respectively, the distance between two satellite is 90 degrees of longitude and about 59,400 km. The delay time increases by 42 ms for each way in comparison to the case that double hop interconnection on feeder links are used. Since the inter-satellite link would be required to communicate several Gb/s, the optical communication technology will be appropriate.

(ii) Number of Cities vs. Number of Antenna Beams: Many high data rate beams can be accommodated unless there is a need for close co-location of the beam patterns. Fortunately, the contiguous beam coverage will not be required for the service area in this satellite, since each city is located at sufficient distance apart throughout the vast region of the Asia-Pacific. In a few exceptions like Los Angeles and San Diego a single beam can be used. Therefore the multibeam antenna itself can be designed from a technical point of view with a high degree of efficiency. Here two 6 beam satellites are examined as an example.

(iii) Frequency Band: The service points are located separately from each other and each beam width is very sharply defined in order to obtain the high EIRP. Thus frequency reuse can be established relatively easily. However, since at least 1 GHz bandwidth is needed for what might be called the super beams, the Ka band and/or millimeter wave band will be appropriate. For the inter-satellite communication, the optical wave is the most appropriate to obtain several Gb/s data rate transmission.

(iv) Link Parameters: According to the link budget, the on-board antennas would need to be of 220 wave length diameter (3.3 m for 20 GHz and 2.2 m for 30 GHz). This would also require a regenerative type of transponder and earth stations of 5 m diameter antenna and a 100 W output power transmitter to accommodate a 1 Gb/s data transmission in the Ka band with a link margin of more than 6 dB and the bit error rate of 1×10^{-7}. Higher level bit error rate performance would be achieved through coding as needed.

(V) Inter-Satellite Link Capability: The inter-satellite communication link would be optical because of the high bit rates. However, the optical space communication technology itself is still relatively immature and this would be one of the key R&D objectives of the project. In short, much improvement of optical ISL technology will be needed over the next five years to allow the particular project to go forward. For purposes of illustration the 2 Gb/s optical intersatellite link is considered here.

(vi) Configuration of Satellite System: Two satellites, assumed to have almost the same size and mass as ACTS will be connected by optical inter-satellite communication link. It would have 6 super beams, plus one broad coverage beam for regional interconnectivity. The six super beams would be created by two on-board antennas produces the system configuration as shown in **Figure 2.** The regional coverage beams are not shown but would be like a modified INTELSAT regional beam.The total bandwidth of this satellite is approximately 10 GHz (6 superbeam satellite-earth links, 1 regional beam and 2 inter-satellite links). To organize the satellite as a realizable 2 ton class satellite would be one of the key points of technology development.

4. NEW CONCEPTS FOR 21ST CENTURY SATELLITE SYSTEMS

4.1 Examining and Evaluating New Ideas

In recent years there has been considerable stress on the idea that the U.S. and Japan are locked in various forms of competition related to trade, technical innovation, management and productivity.
It seems important in this context to recognize that these countries natural trading partners, and that in the context of the Asia-Pacific region Canada, Mexico, Japan, and the U.S. are each others primary trading partners. The future of the U.S. and Japan are in many ways riding of the success of the Asia- Pacific region and if there are new and innovative ways to collaborate within the region it will likely be to their mutual benefit. Some of the ideas that follow are new and unconventional but even so they hold the potential and promise of a new Century.

4.2 New Ways to Use GPS Packages On Low Orbit Satellites in the Asia-Pacific Region to Monitor Global Warming.

There are today dozens of satellites equipped with Global Positioning Satellite receivers for navigational purposes. The number of these GPS satellites in low earth orbit are scheduled to increase dramatically in the next few years as lightsat mobile satellite systems are deployed. It is possible to use this capability not only for navigational aids and mapping, but this capability can aid with the so-called mission to planet earth and in particular with the monitoring of the earth's atmosphere. The creation of complex computer models and conversion formulas can allow derivation of atmospheric density, atmospheric temperatures at different altitudes and even atmospheric composition. The key to this operation is that radio occultation measurements between GPS satellites and low orbit satellites with GPS receivers can be inverted to provide critical data. In particular they provide refractivity profiles, from which new computer models now being developed in the USSR and at NCAR in the US can calculate density, pressure and temperature. These are not yet totally accurate models and reading accuracy can be affected by water vapor variability. Nevertheless, accuracy in the range of 2 degrees K accuracy is estimated for tropical rain forest areas at altitudes below 8 kilometers. In the rest of the accuracies of 1 degree K is estimated for the atmosphere at altitudes of 7 to 35 kilometers.

This is a remarkable new effort that indicates that global atmospheric monitoring could move ahead much more quickly than previously thought possible. The coordinated effort to use GPS receivers in this manner throughout the Asia-Pacific Region would be appear to be an important humanitarian role that the U.S. and Japan should actively support and provide active financial support in order that this undertaking could be accelerated. (See Reference 6).

4.3 New developments in USAT (Ultra Small Aperture Terminal) technology to aid rural and remote services.

The evolution of satellite communications has been described as that of "technology inversion". This simply means that over time satellites have gotten larger, more powerful, more "intelligent"

and more capable. At the same time the earth station antennas on the ground have gotten smaller, used less power, become more mobile and light weight, and decreased greatly in cost and price. This is a logical transition from an economics and service perspective. Since there is just one satellite per service area but a very large number of earth station antennas, if you can transfer the function to the satellite you only have to do it once as opposed to hundreds or thousands of time. With the advent of on-board processing as demonstrated by ACTS and ETS-VI, a new capability comes to the fore in terms of having the satellite connect remote antennas directly to other remote antennas, rather than interconnection through a hub or star configured master antenna. Suddenly satellites do not have to be hierarchically arranged like a terrestrial network. All antennas in a service area can connect directly to each other. This suggests that in the future very large "mesh configured networks" can be used throughout large regions with a high degree of cost efficiency. It not surprisingly gives rise to concerns about bypass of established telecommunications networks as well.

The key to this dramatic new capability becoming possible is truly low cost and compact ground antennas. In the past 5 years, VSAT technology has burst on the scene. INTELSAT has gone from 3 earth station standards including the 30 meter Standard A to 13 standards that includes a 75 centimeter INTELNET receive only antenna not much different in size than a pizza pan. This trend is far from over. The GEOSTAR network developed a receiver with a very low rate return channel that looked and felt a lot like a garage door opener device, and weighted the same as a book. The Jet Propulsion Laboratory (JPL) is designing a very small mobile antenna for a car or truck which will be tested with the ACTS satellite. In more advanced studies, JPL is doing a design study for a personal communications system that would use a very small hand held transceiver, and even more dramatically there are some 8 mobile satellite systems that have been filed in the United States for a direct to the subscriber mobile service to supplement cellular radio systems. Some of these systems such as Globestar and Iridium are intended to be mobile in scope.

The key point is that today we are being to transition from antennas in the 1.2 to 3.0 meter range which we call VSAT, to a new era that is defined by antennas (often conformal phased arrays) that are 50 centimeters or below in diameter. The applications with initially be for lower data rates and very low speed "recognizable" voice (e.g. 1.2 kbit/s) but they will grow over time. The applications are today varied and important. These applications include remote power readings, emergency alarm systems, weather alerts, network management controls for oil companies, shipping lines, etc. These technologies could have immediate application in many Pacific island countries today, especially where no communication capability now exists.

A concerned effort to build "smart" computer assisted USAT antennas, using phased array antenna technology is another "leveraged project" where U.S. and Japanese cooperation might assist the region and their earth station manufacturing industries.

4.4 Concept Studies to Create 21st Century Satellite Systems That Have High Performance and Reliability With Minimum Transmission Delay and Easy Interconnection Into Terrestrial Systems.

The easiest tendency is to look at history as linear with steady ranges of change over time. Any student of history knows that progress and regression tends to come in spurts. The satellite industry with development of lightsats, low-orbit mobile satellites, USAT, and "intelligent" satellites is currently in the midst of what seems to be a significant thrust forward. The challenge of fiber optic cable and the drive to create super reliable, super fast, error free networks with virtually no transmission delay and "streamlined" overheads in data cells all suggest that satellites need a major paradigm shift that goes beyond conventional geosynchronous satellite technology. Under studies now under way at the University, totally new concepts are being evaluated as to their feasibility in terms of technology, operational viability, financial cost , frequency allocations, health and safety factors and technical standards.

These concepts vary greatly in terms of cost, technical feasibility, and dates of possible implementation. Those under active study at this time are listed below to show the diversity of approaches that could become possible at a future date:

(a) Optical Satellite Cables in the Sky: The transmission of optical signals can clearly be accomplished across space. A 60,000 kilometer ISL connections is, in fact, presented in Section 3. The problem is getting an optical signal from the earth surface to above the atmosphere. One proposal is to use aerostats tethered by optical fiber as the cablehead for space transmission.

(b) Drone-Stablized Geosynchronous Platforms in Low Earth Orbit. If this concept could prove economically feasible and operationally reliable, then it could solve some major problems with transmission delay, path loss, antenna pointing, and overall capacity and performance. NASA experimented with this concept over a decade ago and abandoned the project. Creating drone planes with the cybernetic capabilities needed for long term operation may now be within reach. The environmental aspect of such a concept would need particularly close scrutiny.

(c) A Ground Based Power Transmission System for Stabilizing a "Spidersat" in Low Earth Geosynchronous Orbit. The idea of a low earth geosynchronous orbit is not new. Arthur Clarke wrote of it over a decade ago. He has indicated, however, that he was not certain how it would or could be done. The SHARPS project in Canada has perhaps indicated through its ground powered microwave transmission to a drone plane flying up to 13 miles high how it could be done. If you could build a satellite that weighted only 20 kilograms, it would be possible to stabilize it at an altitude of some 500 miles with transmission of about 50 kilowatts. (This is equivalent to powering a Honda or Ford Escort at about 45 miles per hour). You might as what good would a 20 kilogram satellite, but with no solar cells or batteries or stabilization, all that would be needed is mylar antennas and microcircuitry. This "Spidersat" might be able to generate a million equivalent voice circuits. or provide a thousand video channels.

This is not a complete list of advanced concepts but it does help underline the fact that there still some new ideas and possible new innovations for the field of satellite communications in the 21st Century. Cooperation in advanced concepts is thus yet another way that the U.S. and Japan could work together in the next century.

5. CONCLUSIONS

This article is but a brief resume of a much longer report and study. When completed the projects selected for recommendation detailed feasibility study may be different from the various projects selected for discussion here. One conclusion, however, seems very clear and that is there are many promising areas where U.S. and Japanese cooperation could be highly productive, economic, and extremely useful to the entire Asia-Pacific region. As a tribute to International Space Year 1992 it would seem highly appropriate for some these preliminary projects to be selected by the U.S.-Japan Committee for detailed review and study with a view to selecting two or three projects for implementation.

The results of these studies will be presented to NASA, the Japanese MPT and NASDA, and the U.S.-Japan Committee to determine their feasibility for implementations.

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ACKNOWLEDGMENTS

A number of people assisted in preparation of this article, as special thanks goes to Gary Bardsley, Peter McDoran, Chris Ketterhagen and the entire research team on NASA Grant NAGW-1105

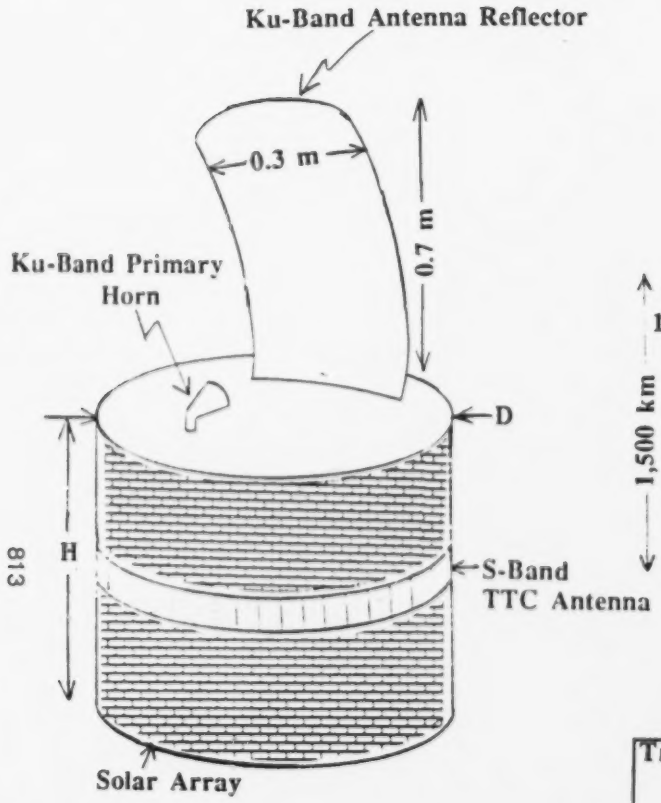
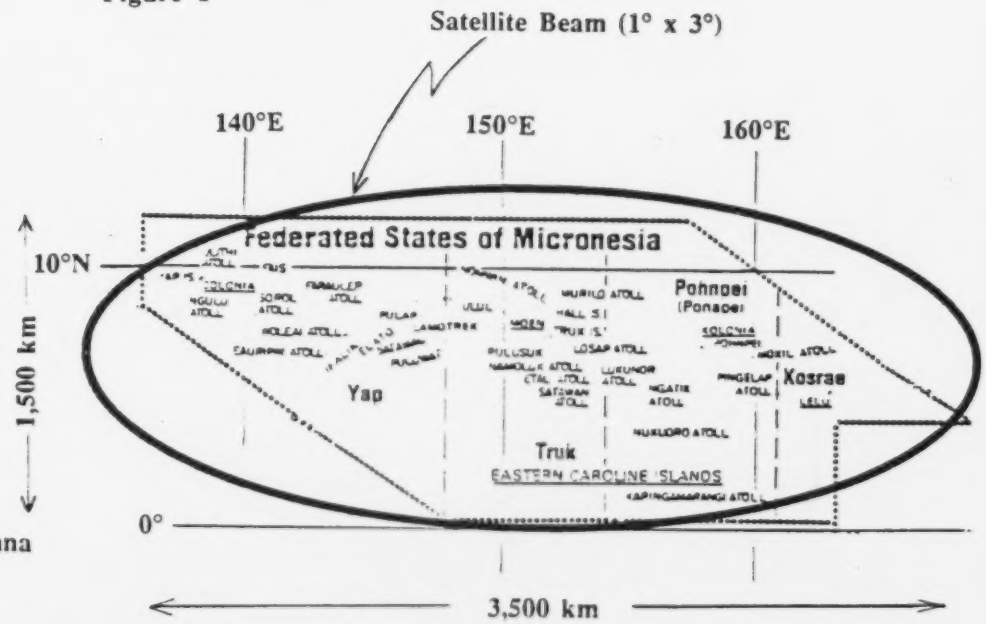


Figure 1



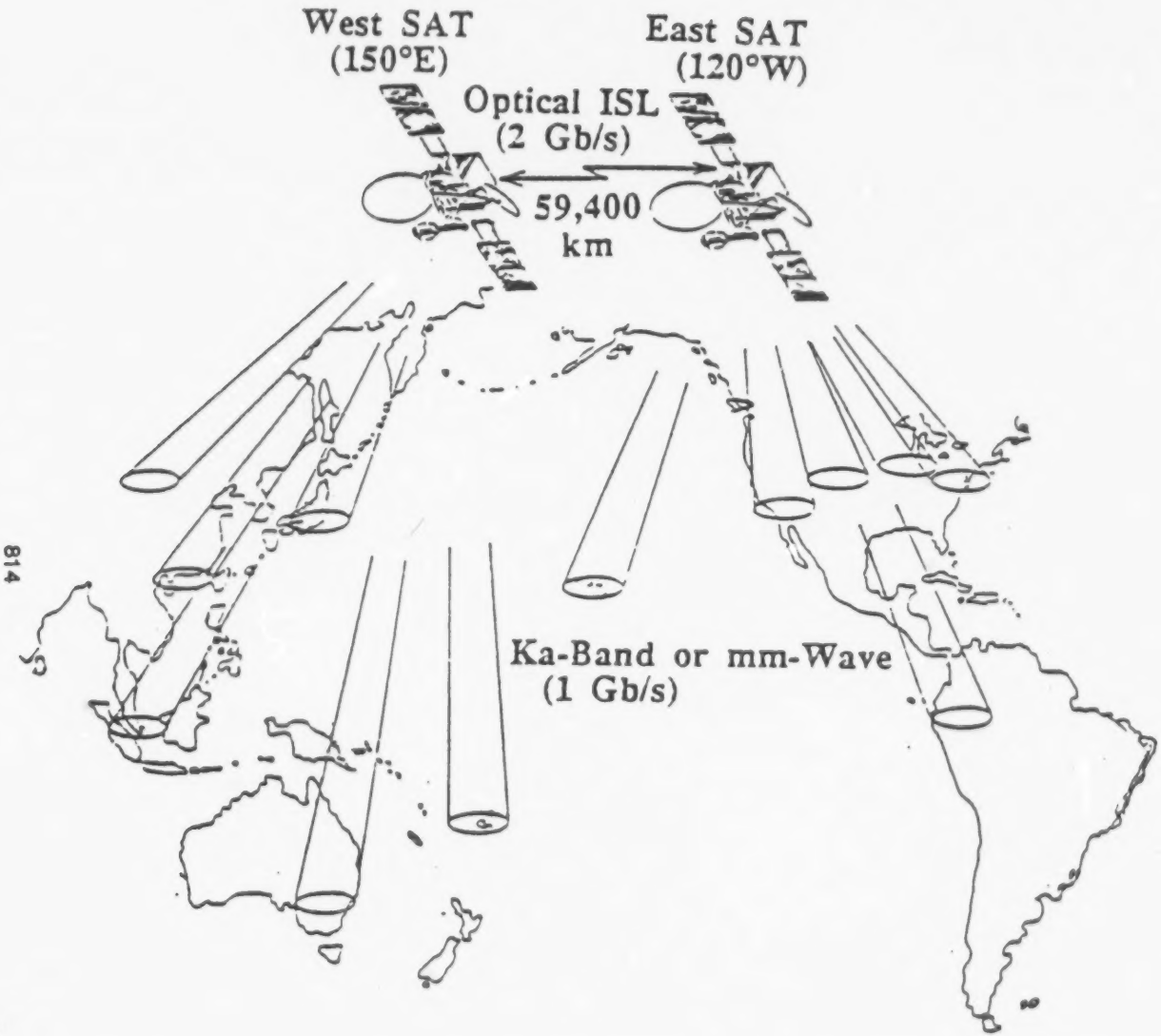
Diameter D(m)	1.2	1.4
Height H(m)	1.2	1.4
Solar Array at EOL (Watts)	226	308
Weight in GEO (kg)	90	130
Mission (kg)	*20*	*30*
Bus (kg)	*40*	*55*
Fuel (15 years)(kg)	*30*	*45*

Transponder	
Number of Circuits	150
Bandwidth	60 MHz
Output Power (Saturated)	75 Watts
Type	TWTA
Weight	8 kg
Consumption Power	123 Watts

2 Transponders On-board
One Operational
One Redundant

Concept of FSM DOMSAT

Figure 2



Conceptual Desion For The Advanced Asia-Pacific Telecommunicatons Satellite (AAPTS)

Pan-Pacific Information Network System Using ETS-V

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1. ABSTRACT

The transportable earth stations were developed for the purpose of Pan-Pacific Information Network Experiment using Engineering Test Satellite V (ETS-V) satellite. ETS-V has two antenna beams and covers north and south-west part of Pacific ocean. 64 kbps QPSK was employed for the system. 64 kbps full-duplex satellite link enables TV conference or multiplexed voice and data communications.

2. PAN-PACIFIC INFORMATION NETWORK EXPERIMENT

2.1 OBJECTIVES OF THE EXPERIMENT

This experiment is carried out using ETS-V in the L-band frequency for the Pan-Pacific information network study. The Pan-Pacific information network for mutual communication and information exchange specially for non-profit, educational purpose is desirable to be constructed by using low cost and simple earth stations. For the future network, digital technology, especially, visual communication is important to study. Therefore, the objectives of the experiment are summarized as follows;

(1) To show applicability of 64 kbps digital satellite link.
(2) To discuss operationability of L-band frequency.
(3) To study how to manufacture the simple and low-cost earth station.
(4) To find requirements of the future satellite system.

2.2 CONFIGURATION OF EXPERIMENTAL SYSTEM

Fig. 1 shows L-band antenna coverage of the ETS-V. The communication experiments are carried out between Japan and Hawaii. In this case, position of Hawaii is edge of the north beam, and the satellite antenna gain is 7 dB lower than that in Japan. In order to keep receive signal quality, the bigger antenna is prepared for the transportable earth station.

L-band to L-band loop-back mode of the satellite transponder is used for this experiment. Therefore, Two earth stations for both side of the satellite link were developed.

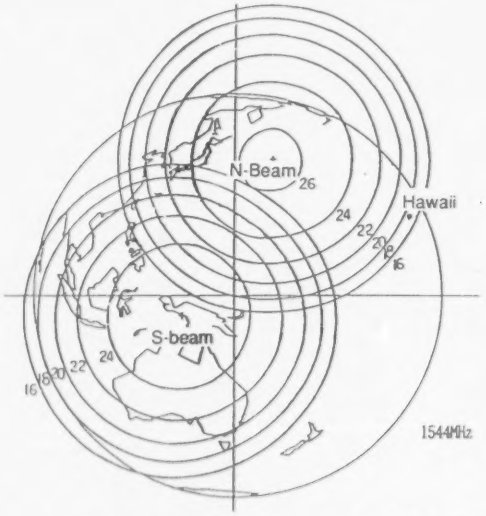

Fig. 1 L-band Antenna Coverage of ETS-V

64 kbps digital transmission link was selected for the basic satellite link, in order to communicate with both voice and compressed video signal. TV telephone signal can be transmit with 64 kbps satellite link. Furthermore, 64 kbps digital data can be divided into the voice channels and data channels.

3. DEVELOPMENT OF TRANSPORTABLE EARTH STATION

3.1 SPECIFICATION OF EARTH STATION

The configuration of the transportable earth station is shown in Fig. 2. The earth station consists of the outdoor unit and indoor unit. The outdoor unit

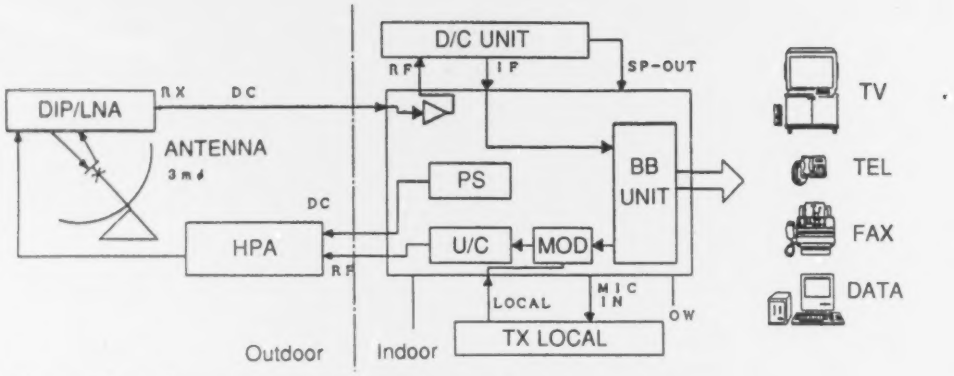

Fig. 2 Configuration of Transportable Earth Station.

includes the antenna, high power amplifier (HPA) and the low noise amplifier (LNA). The indoor unit divide into three boxes which are the amateur radio transceiver, general coverage receiver and the developed digital modem. The amateur radio transceiver is used for the carrier generator for QPSK modulator and FM signal generator for the voice communication. The general coverage receiver is used for the receive frequency down-converter, and IF output of the receiver is connected to the QPSK demodulator. Summary of the main specification is shown in Table 1.

Table 1. Specification of Transportable Earth Station

TX Frequency	1644 - 1645.5 MHz
RX Frequency	1542 - 1543.5 MHz
Antenna	3m diameter Parabolic
HPA	GaAs FET 10W Linear AMP
Modem	Data link: 128kbps QPSK Voice link: Narrow band FM
FEC Coding	Convolutional Coding (R=1/2, K=7)
FEC Decoding	Viterbi algorism, 4bit Soft Decision
Data rate	64kbps TV conference
Multiplexed Data	16kbps Voice Data: 2CH 9.6kbps FAX Data : 1CH 4.8kbps PC Data : 2CH
Voice Coding	Adaptive delta modulation

The convolutional coding, Viterbi decoding algorism is employed for the forward error correction (FEC). The FEC coding rate of 1/2 is selected. Therefore, 64 kbps of data rate is converted to the 128 kbps RF transmission rate. In order to minimize the band-width, QPSK modulation technique is employed for L-band to L-band link of the satellite transponder which total band-width is limited to 300 kHz.

3.2 LINK BUDGET OF ETS-V

The link budget of the L-band to L-band satellite link of ETS-V is shown in Table 2. Two signal from each earth station are amplified by the satellite L-band transponder, when the full duplex communication is carried out.

Table 2. Link Budget of ETS-V

TX earth station	Tokyo	Hawaii	
RX earth station	Hawaii	Tokyo	
TX Power	2.5	5.9	dBW
TX EIRP	34.1	35.9	dBW
Propagation Loss	188.3	188.0	dB
Satellite G/T	-4.7	-10.4	dBK
Up-link C/No	69.7	66.2	dBHz
Satellite TX PWR	7.0	3.5	dBW
Satellite TX EIRP	19.5	23.6	dBW
Propagation Loss	187.7	187.7	dB
Earth station G/T	6.5	6.5	dBK
Down-link C/No	66.9	70.5	dBHz
Total Link C/No	65.0	65.0	dBHz
Required C/No	56.0	56.0	dBHz
Link Margin	9.0	9.0	dB

Notes) Antenna diameter: 3m
Back-off of the satellite transponder: 3dB
Implementation Loss: 4dB

The link budget shows that the full-duplex communication link is available with 9 dB of the link margin.

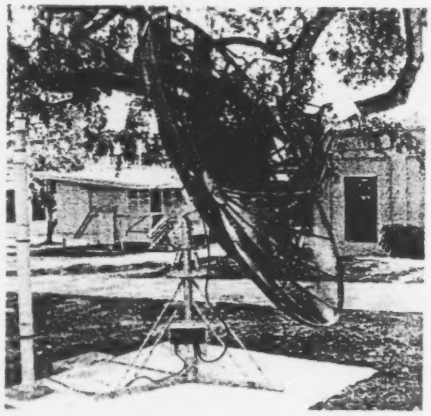

Fig. 3 Antenna System.

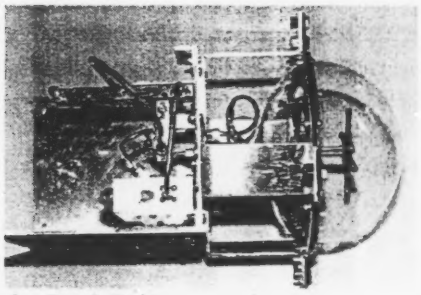

Fig. 4 Feed Unit.

3.3 RF SYSTEM OF EARTH STATION

1) ANTENNA SYSTEM

Fig. 3 shows the antenna system. 3 m diameter mesh type parabolic reflector is used for the antenna. Fig. 4 shows the feed unit which include the cross dipole antenna, the diplexer and the low noise amplifier. The 10 W high power amplifier is installed on the base pole.

2) DIPLEXER

The diplexer is used for the full-duplex system. The diplexer works as an isolator between transmitter and receiver. The functions of the diplexer are to attenuate TX signal at the LNA input, and to attenuate the noise power from the HPA at receive frequency. Fig. 5 shows the signal levels around diplexer.

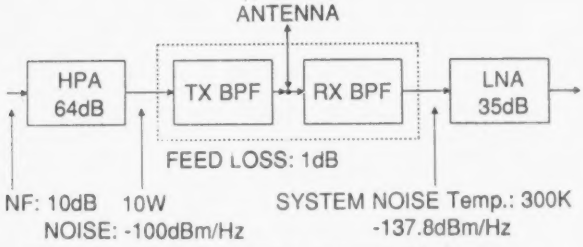

Fig. 5 Signal Levels Around Diplexer.

Since the gain of the LNA is about 35 dB, input signal level of the LNA should be less than -40 dBm, in order not to saturate the LNA. Therefore, the attenuation of the RX band-pass filter (BPF) in the diplexer should be higher than 80 dB, in case that the transmission power is 10 W.

On the other hand, the wide band noise generated from the HPA should be attenuated by the TX BPF in the diplexer. As shown in Fig. 5, receive noise level at the LNA input is estimated to be -173.8 dBm/Hz, when the RX system noise temperature is 300 K. Since the noise power at the HPA output is estimated to be -100 dBm/Hz, the attenuation of the TX BPF in the diplexer should be higher than 80 dB.

Fig. 6 shows the diplexer unit. In order to reduce the size and weight of the diplexer, the di-electric resonator is used for the filter element. In this case, the attenuation of the diplexer is 65 dB. Therefore, simple BPF is added after the diplexer.

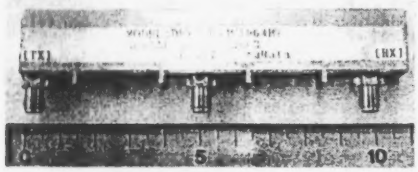

Fig. 6 Diplexer Unit.

3) LNA

Conventional LNA is used for the earth station. Noise temperature of the LNA is 70 K.

4) HPA

Fig. 7 shows the block diagram of the HPA unit. A GaAs FET power module is employed as a main amplifier. In order to reduce the wide band noise generated from the power amplifier, BPFs are inserted at the input and output of the amplifier.

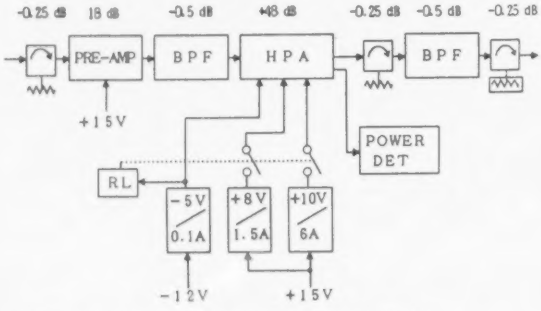

Fig. 7 Block Diagram of HPA Unit.

The linearity of the HPA is shown in Fig. 8. The maximum output power at 1 dB compression point is 41 dBm. The noise spectrum of the HPA is shown in Fig. 9. The carrier to noise power density ratio at TX frequency is about 139 dBHz. The noise power density at RX frequency is less than -150 dBm/Hz. Since the noise is attenuate 65 dB by the diplexer, the noise does not affect the receive system noise.

5) RX FREQUENCY DOWN-CONVERTER

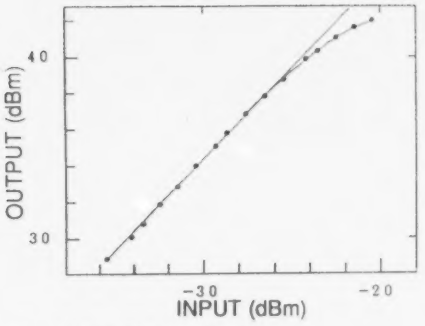

Fig. 8 Linearity of HPA.

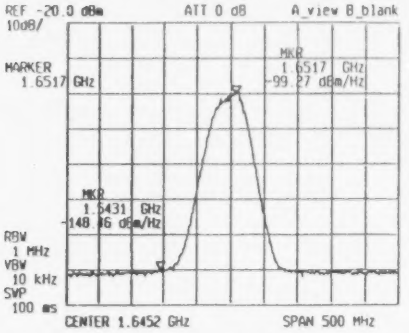

Fig. 9 Noise Spectrum of HPA.

A General coverage receiver is used for the RX frequency down-converter. The stability of the receiver is 0.25 PPM, and receive frequency at L-band can change 10 Hz step. Fig. 10 shows the Phase noise performance of the receiver. Since the phase noise level at 1 kHz offset point is 66 dBHz, this receiver can be used for the 64 kbps data transmission.

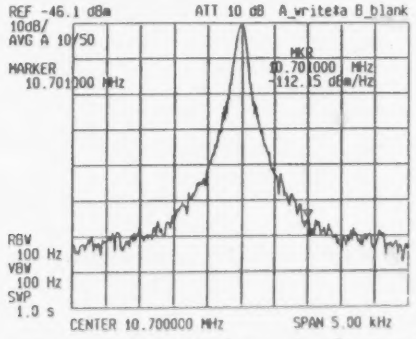

Fig. 10 Phase Noise Performance of Receiver.

6) TX FREQUENCY UP-CONVERTER

Fig. 11 shows the block diagram of the TX frequency up-converter. 145 MHz TX IF signal is up-converted to the L-band

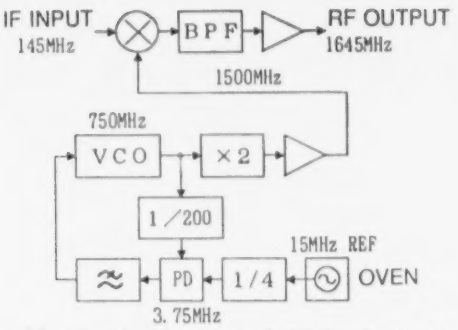

Fig. 11 Block Diagram of TX Up-Converter.

signal with 1500 MHz local signal. The local signal is generated by using 750 MHz phase lock loop oscillator which is locked to 15 MHz oven controlled reference oscillator. The frequency stability of the local oscillator is within 1 kHz.

The phase noise characteristics of the local oscillator is shown in Fig. 12. The C/No of the local signal has obtained to be 95 dBHz at the 40 kHz offset point from the local frequency.

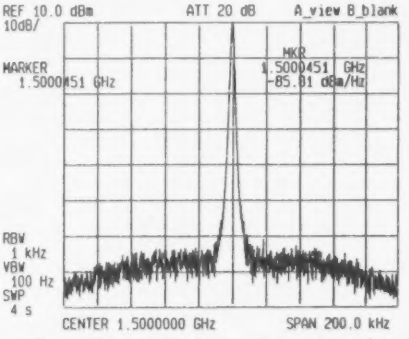

Fig. 12 Phase Noise Characteristics of Local Oscillator.

3.4 QPSK MODEM UNIT

1) QPSK MODULATOR

The configuration of the QPSK modulator is shown in Fig. 13. In order to simplify

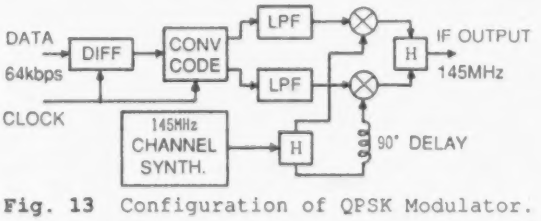

Fig. 13 Configuration of QPSK Modulator.

the circuit, two data streams at the

output of the convolutional encoder are connected to I and Q channel of the quadrature modulator respectively. The differential encoding before the convolutional encoding is prepared to solve phase ambiguity problem at the receiver. A seven stage convolutional encoder is used as shown in Fig. 14.

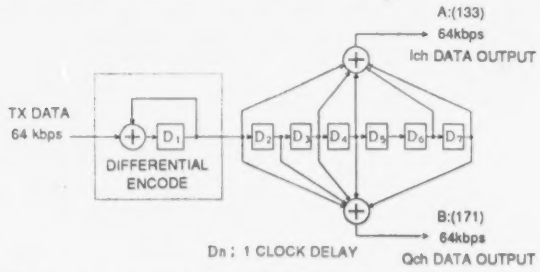

Fig. 14 Convolutional Encoder.

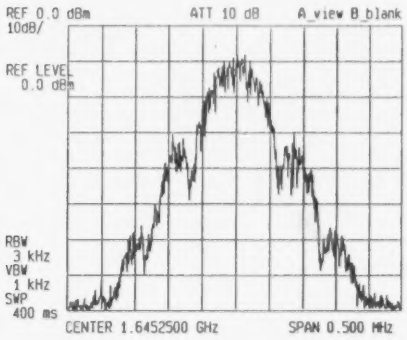

Fig. 15 Spectrum of Modulated Signal.

Fig. 15 shows the spectrum of the modulated signal. In order to reduce the band-width of the modulated signal, The LPFs of BT = 2 are adopted at the input of the quadrature modulator.

2) QPSK DEMODULATOR

Fig. 16 shows the configuration of the QPSK demodulator unit. 10.7 MHz received IF signal is demodulated by using the Costus loop carrier recovery circuit. The clock signal is regenerated from the signal transient of the I channel demodulated signal by using the digital PLL clock regenerator. I and Q channel of the demodulated base-band signal is quantized to the 4 bit data respectively, and input to the Viterbi decoder IC.

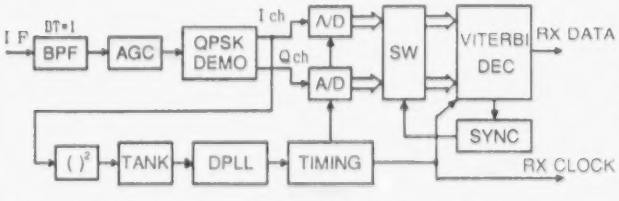

Fig. 16 Configuration of QPSK Demodulator

3) VITERBI DECODER

In order to solve the phase ambiguity problem of the QPSK demodulator, the exchange switch and data invertor circuit is needed at the data input of the Viterbi decoder. In case that the recovered carrier phase has 90 or 270 degree offset from TX modulator, the Viterbi decoder cannot decode correct data because the I/Q channel data is replaced by the Q/I channel data. Therefore, the data exchange and invertor circuit works when the Viterbi decoder output the error flag.

In case that the recovered carrier phase has 180 degree offset, The Viterbi decoder works correctly and outputs inverted data. Data inversion can be solve by using differential decoding circuit.

3.5 BASE-BAND UNIT

1) DATA MULTIPLEXER

The data multiplexer and demultiplexer is prepared for the voice and data communication using 64 kbps modem. Two channel of 16 kbps voice data, 9.6 kbps of the FAX data, two channel of 4.8 kbps PC data and the frame synchronization data is multiplexed to 64 kbps data. Fig. 17 shows the frame format of the multiplexed data. One frame consists of 40 bits of data. 8 bits of the frame synchronization pattern is put to the top of the frame. The data scramble pattern is multiplied to the 32 bits of the data part.

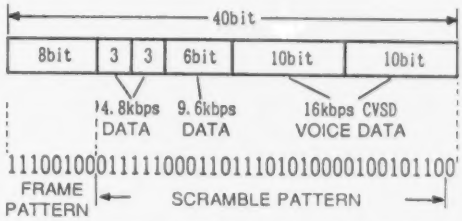

Fig. 17 Frame Format of Multiplexed Data.

2) DATA DEMULTIPLEXER

The configuration of the data demultiplexer is shown in Fig. 18. The demultiplexer detects the frame synchronization pattern and divide each data to respective data rate. In order to simplify the frame synchronization control, the frame counter is initialized under the condition of a series of four frame pattern detection. The probability of false synchronization can be calculated as $1/2^{32}$. This value is about 2.3E-10, and small enough for the simple earth station.

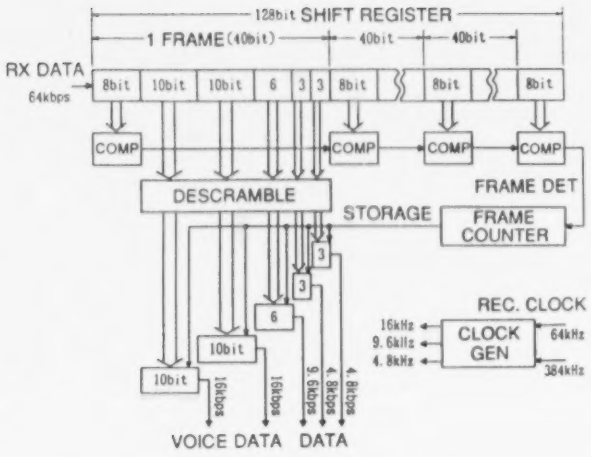

Fig. 18 Configuration of Demultiplexer.

3.6 TV CONFERENCE SYSTEM

The connection of the video equipments is shown in Fig. 19. 64 kbps TV telephone system (INVITE 64) is used as the TV signal codec. Normal TV telephone system need not the echo canceler, because the headset or handset is used both side of the station. However, the echo canceler is essential for the TV conference, in order to reduce the echo generated in the conference room.

4. CONCLUSIONS

The low cost transportable earth stations were developed for the Pan-Pacific information network experiment, which is started between Japan and Hawaii. The first TV conference experiment was carried out between Kobe, Japan and University of Hawaii, for Symposium on the Establishment of a Pan-Pacific Information Network on Nov. 1990. Through this experiment, 64 kbps TV telephone codec gave us enough information in the conference, and we could find easily who was a speaker, or we could read the viewgraphs with big character.

L-band frequency is easy to handle because the transistors and ICs are available. Therefore, the frequency band from 1 to 2 GHz is the best for these kind of simple satellite communication projects.

For the Pan-Pacific information network experiment, we have finished the earth station with low cost. However, we realized that the wiring of the logic circuits is a time consuming job. Therefore, we decided to use the computer aided design tools for the field programmable logic array or logic cell array instead of wired circuit board for the new earth station. The improved video codec which meets CCITT standard H.261 is also under development.

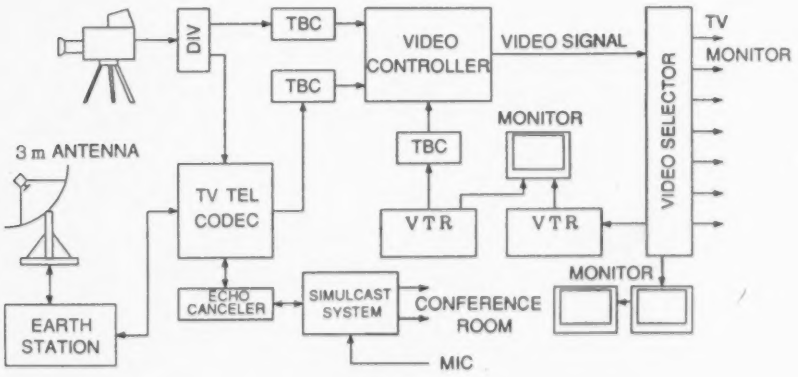

Fig. 19 Connection of Video Equipment.

ACKNOWLEDGEMENT

We would like to thank Prof. Topping, Ms. Mukaida and PEACESAT people of University of Hawaii for their cooperation and encouragement. We also thank the people concerned of CRL, MPT, NASDA, Tohoku University, University of Electro-Communications, Kobe University, Hyogo Prefectural Government and the Organizing Committee of PAN-NET'90 for their support and cooperation. A part of this work is supported by the Okawa Institute if Information and Telecommunication and Research and Development Center for Radio Systems.

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OVERVIEW TO ASEAN REGIONAL TELECOMMUNICATIONS DEVELOPMENT INTERESTS IN A GLOBAL ENVIRONMENT

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ABSTRACT

A broad overview to the regional interests of the ASEAN countries in developing telecommunications and information systems is presented in the context of global issues of systems and services growth as well as policy evolution. A mosaic of interrelated issues are discussed in order to understand the context of ASEAN as a regional force capable of affecting significant impact on the global telecommunications environment.

1. INTRODUCTION

The 1990s may well be looked at as landmark years for the development and assertion of regional interests of the ASEAN (Association of South East Asian Nations) in a global environment. The ASEAN countries have renewed pledges and strengthened action plans toward building a lasting peace in the region as well as developing cooperative measures for the enhancement of economic development. Without a doubt, events in Eastern Europe, the European Community, the Soviet Union and Middle East have and continue to occupy our attention internationally. Nonetheless, a real dynamism (if less dramatic) in terms of working toward a political maturity and economic development rests squarely with the Asia-Pacific region. The ASEAN countries in particular are becoming a collectively strong player in the development of trade relations, industrial and information sector growth as well as a leader in regional development with global implications. As global services and systems become more the norm of operation in telecommunications, strengthening national and regional systems has become a major priority for the ASEAN countries. This is being done not only to bring up the quality and quantity of infrastructure and services to meet an ever increasing demand domestically, but also to be positioned to both cooperate equitably and compete selectively in expanding global markets.

With the recent positive progress toward a lasting resolution of the Kampuchea (Cambodia) issue and the beginnings of change toward economic and political cooperation with the entire Indo-China region, the ASEAN countries have begun to succeed in the task of developing cooperative and consultative relations with each other and with other nations in the region to solve political disputes. These political links are translating rapidly into economic links and telecommunication development has become an important part in the realization of development goals. The ASEAN countries are responding quickly to telecommunications development needs in Laos and Vietnam with Kampuchea not far behind. Sights are now set on beginning to ease the strained relations with Myanmar (Burma). The whole of Southeast Asia is nearly poised to begin a developmental period which will launch the region, during the rest of the 1990s, into becoming a major player in the international arena.

Sophisticated regional economic cooperative links are being forged in the wake of increasing political stability. As the political and economic clout of the ASEAN countries continues to grow, regional telecommunication interests in mobile systems, satellites and undersea cable systems, as well as rapidly growing value-added services are of primary concern. The integration of these services and systems with both global

networks and developing domestic basic infrastructure is becoming an increasingly complex task. Pressure to reorganize government owned, monopoly telecommunication authorities continues.

At the same time, these organizations are expanding internationally and are beginning to assert concomitant interests in international trade relations. However, while some reforms are evident, the revision of policy and internal practices tend to lag behind these developments creating a cumbersome brake on otherwise well intentioned change for both domestic development and international expansion. A mosaic of interrelated issues are presented in this paper to better understand the context of the ASEAN's development into a regional force capable of affecting a significant impact on the global telecommunications environment.

2. ASEAN ECONOMIC INTERESTS

A new economic framework agreement was accepted in late 1991 which sets a clear direction for a workable cooperation among the ASEAN nations. This framework agreement is aimed at creating a regional free trade area within the next 10-15 years. Originally proposed by Malaysia as the East Asia Economic Group (EAEG) in early 1991, the ASEAN countries have since agreed to the term EAEC or East Asia Economic Caucus after combining different proposals from member states. The purpose of the caucus is to eventually lead to building an Asian Free Trade Area (AFTA) among not only the ASEAN countries but also other East and South East Asian nations including Japan.

These economic cooperation developments are significant for a number of reasons. Primarily, they point to an increasing regionalism taking shape as political stability and good regional relations are fostered. This regionalism is in part a response to the development of regional trade groupings elsewhere and the competition it represents including the consolidation of the European Community and the development of a North American Free Trade Area.

Other regional organizations continue to build upon the evident goodwill shown primarily through the renewed strength of the ASEAN grouping. The Asia Pacific Economic Cooperation (APEC) was initially concerned that the development of an Asian Free Trade Area under the sponsorship of the EAEC would undermine APEC primarily as the EAEC does not include the United States. Whether APEC's role is diluted as a result of more compact regional agreements is yet to be seen. It seems however that the trend in the region for growing economic linkages will allow such forums as APEC to begin to assert itself in terms of removing barriers to trade, promoting further investment and developing technology, information and people.

Nonetheless, such regional structuring has not prevented bilateral trade agreements from being formed at the same time. Recently, Singapore signed a Trade and Investment Framework Agreement (TIFA) with the United States. While some may find that such bi-lateral arrangements are an effort on the part of the U.S. to purposefully circumvent the EAEC, a more lucid analysis would find that such arrangements are pragmatic to both parties and allowable under the ASEAN agreement despite a trend to greater regionalism.

Underlying the new economic trade relations, and their corresponding increase in activities, are important changes to the economies of individual countries in the region. Many have prospered with over 50% of the exports of each country consisting of manufactured goods. The ASEAN economies are beginning to achieve comparative advantages in different sectors as the gap between the most developed of the group, Singapore, and the lesser developed countries of the ASEAN is closing.

Major investment and development plans have been implemented including the concept of 'Growth Triangles' which focus on the advantages of each of three bordering countries concerned in furthering economic development. The 'Growth Triangle' concept is currently being put into practice in the development of the region between Johor State in southern Malaysia, Singapore and the Riau Islands of Indonesia. Efforts are primarily concentrated on two relatively large Indonesian islands, Batam and Bintan, which lie just a few miles southeast of Singapore. Investment in manufacturing, tourism, transportation and telecommunications in this growth triangle area already total more than $1 billion with Singapore providing some 40% of the investment funds. Interestingly, such investments have had the side effect of propelling the Singapore dollar toward becoming an international currency, yet another indicator of the growing economic dynamism of the region. Indeed Singapore, for all intents and purposes, will be a developed nation by the year 2000. Malaysia has ambitious plans to follow suit by 2020.

3. REGIONAL TELECOMMUNICATIONS EVOLUTION

ASEAN regional economic cooperation has lead to the development of many new relations in various sectors of the economies of the nations concerned including the development of telecommunications systems. In the Growth Triangle arrangement for example, Singapore Telecom has entered into a joint venture development with PT Telekom (formerly PERUMTEL) of Indonesia, the Salim Group and other private concerns to develop the telecommunications infrastructure on Batam and Bintan islands. The new telecommunications facilities, primarily basic services and an international gateway, coincide with the manufacturing and tourism industries being developed. In fact, a shift in policy toward foreign ownership of telecommunications facilities in Indonesia was made to fit the specific development needs of the situation. A joint venture arrangement allows Singapore to both own and operate the basic systems through a revenue sharing scheme for an extended period before finally transferring the system to Indonesia. Such an arrangement has been possible only through the very pragmatic developments in trade relations and an increasing reliance on the various strengths of regional countries to enhance development efforts within each other's country.

Trends toward various forms of privatization, private participation and deregulation in telecommunications in the ASEAN countries have been noted previously.[1] In Singapore and Malaysia in particular where privatization of the telecommunications authorities are in various stages of progress, the need to expand beyond the domestic markets are evident. [Several papers in this Proceedings deal with privatization in the ASEAN countries: 3.2.3.5, 4.3.3.4, and 4.3.3.5.] Singapore Telecom is currently involved in various joint venture and consultancy roles in many countries in Asia. Both Singapore and Malaysia are looking toward developments in Vietnam as relations with that country are soon to be normalized. In fact, the political situation is such that open discussion on the possibility of Vietnam becoming the seventh full member of ASEAN has ensued. Efforts are beginning now for ASEAN member countries to take advantage of their own strategic position in providing telecommunications expertise and investment to Vietnam as well as other regional nations.

Another very important trend in the ASEAN region, indeed in the entire Asia-Pacific region, is the increasing demand for the provision of mobile services including cellular telephony. With a rising GNP per capita, increasing available disposable income, multiple market operators and an increasing telephone line penetration in general, the subscriber base in the Asia-Pacific region for cellular systems is on the increase. In the ASEAN region alone, the subscriber base is already between 50,000 and 100,000 users in Thailand, Singapore, Malaysia and Brunei and rapidly increasing. Within a country, the degree of competition in cellular services to a large extent influences marketing and distribution issues as well as coverage and capacity considerations. With the exception of Singapore, which operates an efficient island-wide cellular system from the sole monopoly telecommunications authority, competition in a liberalized cellular market provides for cheaper equipment and service prices with a higher quality of service.[2]

Mobile telephone services will become an increasing regional as well as international issue as user demands increase in terms of specific market use as well as use of mobile telephones in other locations. Issues of standards and compatibility, access and tariffing for mobile systems will become ASEAN and Asia-Pacific wide regional issues in the near future.

4. COMPETITION AND COOPERATION

Both cooperative and competitive forces are beginning to shape telecommunications developments in the region. An increase in cooperation for telecommunications development is simultaneously taking on a keen competitive side as the various telecommunications authorities of the region begin to flex interests internationally.

International competitive interests are also on the increase in the ASEAN region. Competition in the provision to governments of basic service infrastructure is as keen as markets for sophisticated value-added services. In addition, the trend toward global mergers and alliances of entities with telecommunication concerns spells an even greater strategic positioning of organizations wishing to participate in the markets of Southeast Asia.

With the increasing investment in telecommunications development in each country, private organizations both domestic and foreign are keen to take part. Deregulation of the CPE market in most countries as well as the push toward both privatization of the various telecommunications authorities and an increase in private participation in network and services development means competition for lucrative contracts and various revenue sharing schemes are on the rise. For example, Northern Telecom's UK-based STC Submarine Systems (with an executive office in Singapore), in a joint venture with Thai partner Jasmine International, recently won a $100 million contract from the Telephone Organization of Thailand (TOT) to install an undersea telecommunications network in the Gulf of Thailand. The competitive tender contract was awarded under Thailand's build, operate and transfer scheme and is being financed principally by banks and financial institutions in Thailand.

At the same time that competition for telecommunications markets is increasing, growing cooperation in the ASEAN region and indeed in the entire Asia-Pacific region is evident in the domain of telecommunications development. Such cooperation is acting as a catalyst to change as discussions and activities of the various organizations concerned invariably involve complex issues of management and policy change.

In the area of regional cooperation, several developments are worth noting. With the continual extension of the ASEAN optical fibre cable network (AOFCN) inter-ASEAN and ASEAN regional links to the world are nearing completion. [Details of this network appear in paper number 4.2.3.2 of these Proceedings.] In addition regional network planning, traffic analysis, and management training continues through the efforts of the Asia-Pacific Telecommunity (APT) based in Bangkok. Such organizations and exchanges of ideas can only help to foster a better environment for telecommunications development in the region in the years to come.

One of the most important factors in the development of telecommunications in the ASEAN region is the diversification of user demands. The convergence of computer and telecommunications technologies has resulted in large scale data transfers requiring networks with enhanced functions to meet growing demands of multiple users.

On a less visible but no less important scale, the proliferation of international and regional information networks to and from the ASEAN countries is evident. For example, ASEANET, an electronic trade information network started in late 1991, has been set up to provide business information linked with various Chambers of Commerce and Industry in the ASEAN region. Members will be able to identify trade opportunities in the region via the network. Plans call for ASEANET to link with equivalent networks in the U.S., E.C., Japan and other East Asian countries notably Taiwan, South Korea and Hong Kong.

Another major technological trend affecting the region is the merger of broadcast and telecommunications technologies. The results of this merger are just beginning to shift programing and distribution modes away from the monopoly of the national broadcaster and into the realm of international partners for the diversification of programing.

With the recent launch of Asiasat and the continued regionalization of the Indonesian satellite system, Palapa, many countries are beginning to forge new links through direct lease of transponder capacity. New Zealand TV for example has leased two transponders on Palapa for the delivery of television channels to South East Asia in conjunction with Time-Warner. Agreements are being forged in Singapore (as elsewhere) for downlinking the programmes into the domestic broadcast network through a proposed UHF subscription service and eventually onto a cable television system to be developed jointly by the national broadcaster, SBC, and the telecommunications authority, Singapore Telecom.

Asiasat is also changing the regional telecommunications picture. With the introduction of Star TV from Hong Kong via Asiasat, television programing from that source has a potential audience of over a billion people. Obviously the ability to receive the Star TV signal by viewers in many countries is limited by regulation of TVRO's and/or by costs far beyond the average persons ability to buy reception equipment, limiting for now the size of the actual audience of Star TV.

5. IMPLICATIONS OF REGULATORY EVOLUTION

A common underlying theme to all the diversity in telecommunications development in the region is the need for regulatory policy evolution. The long period of government and monopoly control in many areas of telecommunication is waning in favor of a shift to competitive and cooperative network and service development for a much larger user base. Whether the global drive for changes in the regulatory regime benefits exclusively the larger corporations or can also benefit the smaller user in a low-income country will depend more upon the ability of policy which can eventually reconcile economic gains with wider public interest.

The implications of regulatory changes in the ASEAN countries are being made within the context of the trend toward more open markets for telecommunications systems and services which parallel the general economic trends. The consequence of these cumulative changes has induced a shift in policy from purely quantitative fulfillment of basic telecommunication service to the qualitative improvement of a multiple-source supply of services. The relative importance and influence of Japan, Canada, the U.S. and the European Community in Southeast Asian telecommunications development can be seen in the increasingly keen competition for markets in the region.

In Southeast Asia, the message is clear and gaining an increasingly prominent position in discussions and debates to mandate policy change. A measure of liberalization of markets, regulatory revision and organizational restructuring will help to ensure that telecommunications can fulfill its role in supporting efficient economic and social growth. Whether deregulation and privatization come sooner as in Malaysia or later as may be the case in Thailand and Indonesia, as well as the form of such changes, can only be from the inevitable demand to create networks which eventually provide greater access to meet the needs of users.[3] Regulatory revision, organizational and industrial restructuring, increasing privatization and private participation to include more competitive and cooperative players in telecommunication development are primary in the move to meet a more universal demand.

6. GLOBAL IMPLICATIONS

The dynamic regional economic growth of the ASEAN has put it squarely on the global stage as one of the most important regions for strategic development in the world today. This dynamism is seen in the ever increasing development of telecommunications systems and services throughout the region and in growing network connections globally.

The ASEAN is rapidly becoming a prominent region in the dynamic development of global telecommunications systems. While the promotion of the myth of global networks plays an important symbolic development role in the world today, it is clear that national and to an increasing extent, regional concerns play a far greater role in the development of telecommunications. True global networks, owned and operated by a single entity is simply not a reality despite the exhortations of some such as Cable and Wireless which in mid-1991 completed a network of cables connecting all the continents.[4] The simple fact is no one entity can offer customers their own complete end-to-end full circuits that run across sovereign borders. The fact is that alliances, joint offerings and joint promotions are the make-up of global telecommunications networks in a complex interface of technology, business and regulations.

In essence then, the so-called global network is really an array of global networking comprised of government and private interests across borders to link users with communication needs beyond their own country's boundaries.

In the ASEAN, the growth of local and regional private and public sector telecommunication industries coupled with the expansion of basic infrastructure and enhanced services means that management revision of the state-owned entities and policy revisions are being geared toward meeting new growth potential and meeting ever increasing user demand. The impacts of such regional growth on issues such as tariffing, access and interconnection, gateways, mobile services, satellite systems and by-pass systems as well as needed standardization to meet regional and global integration becomes more pronounced.

What this means for the ASEAN region is a concerted view toward proactive development of the strengths of the national carriers as well as local and foreign participants to the domestic markets. In turn, simultaneous cooperative and competitive focus on the needs of the region as a whole is emphasized. This is part and parcel to overarching economic and political alignment in the midst of the need to connect to a global networking environment. Therein lies the essence of regionalism in telecommunications development. Increasingly, the ASEAN countries are capable of making that development occur in the ways they deem profitable for themselves.

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Telecommunications Network Quality and Export Performance

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ABSTRACT

In this paper we examine the contribution of national telecommunications infrastructure to export performance in the service and manufacturing sectors of developing countries. We place emphasis on trade in producer services, which are now at the center of the current GATT initiative to liberalize trade in services. We also examine the contribution of network quality to aggregate export performance.

1. INTRODUCTION

In this paper we examine the contribution of national telecommunications infrastructure to export performance in the service and manufacturing sectors of developing countries. The recent literature on trade in services has focused attention on investment restrictions and the need to establish a local presence in service export markets. (See Deardorff, 1985; Feketekuty, 1985; Francois, 1990a; Gibbs, 1985; Hindley, 1988). The role of intermediate services as linkages in the coordination and control of the interdependent elements of complex, modern production processes has also been emphasized. (See Francois, 1990b,c). Because traded services are often information intensive, the ability to engage in cross-border service transactions depends critically on available telecommunications facilities in the partner countries. In this paper, we analyze, empirically, the role of national telecommunications infrastructure in this process. We place emphasis on producer services, which are now at the center of the GATT initiative to liberalize trade in services. We also examine the contribution of network quality to export performance in the manufacturing sector.

The results presented here indicate that telecommunications network quality is an important determinant of the pattern of trade in both goods and services. This is consistent with the observation that trade in services often involves cross-border transmission of information, and with the observation that such information flows are also an important aspect of global integration of manufacturing. Our results thus lend support to the notion that the development and modernization of the service sector in third world countries and Eastern Europe, in particular their integration into the global economy, depends on upgrading their underlying telecommunications infrastructure. We also offer evidence that the ability of developing countries to export manufactures can be constrained by their underlying telecommunications infrastructure.

2. BACKGROUND

Telecommunications provides a critical cross-border linkage between producers and their overseas markets. For this reason, a high quality telecommunications system can enhance a country's export performance in a number of ways. Telecommunications linkages may promote exports by facilitating entry into non-traditional export markets. Such linkages facilitate the adoption of increasingly complex production processes and may thus make possible the transition to more sophisticated and more valuable manufactured exports. In this context, a good telecommunications system may also help to attract exporting multinational corporations and encourage the integration of local firms into globally integrated industries.

Additionally, today's "smarter" telecommunications equipment not only transmits information; it can also process it. This capability may allow a country to export a variety of services in addition to traditional manufacturing and primary exports. As an example, Singapore's sophisticated telecommunications system has played an important role in that country's regional dominance of financial services exports.[1] Therefore, as domestic income levels rise and a country's advantage in traditional exports erodes, a well-run telecommunications system may facilitate a transition to "high-tech" manufacturing exports and, ultimately, to service exports.

Table 1

Export and FDI Share of Foreign Service Revenues for U.S. Service Firms

	Export Share	FDI Share
Travel	100	0
Franchising	100	0
Licensing	100	0
Education	98	2
Legal	95	5
Health	61	39
Transportation	61	39
Construction	61	39
Information	50	50
Telecommunications	50	50
Motion Pictures	50	50
Management/Consulting	47	53
Miscellaneous	45	55
Software	40	60
Engineering	25	75
Insurance	22	78
Data Processing	17	83
Investment Banking/Brokerage	16	84
Advertising	15	85
Leasing	15	85
Accounting	8	92
Total	42	58

source: Office of Technology Assessment (1991, p.43).

Because traded services are relatively information intensive, the availability and cost of telecommunications linkages is likely to be

particularly important for international service transactions. This is because services, unlike goods, are consumed as they are produced. This characteristic of service transactions often requires a direct interaction between user and provider. Because of this need for interaction, it may be necessary for the provider of services to establish a presence in the importing country. Once a local market presence is established, services are then traded through the local establishment. As a result, while actual trade involves the cross-border movement of information, equipment, and personnel, the final "traded" service includes a bundle of services that have been both traded and produced locally. Telecommunications network quality can facilitate the interaction between user and provider, and may reduce the extent to which a local presence is required.

Table 1 presents measures of the relative importance, in revenue terms, of local market activities (reported as foreign direct investment or FDI revenue) and the cross-border movement of information, equipment, and personnel, for the foreign service transactions of U.S. providers. It can be seen that while local market activities and cross-border information and factor flows are both important factors in services trade, this varies significantly by service type. For services that are information intensive, such as information services, management/consulting, and engineering, we expect the quality and availability of telecommunications links to have an important effect on the pattern of trade in services.

3. THE BASIC APPROACH AND DATA

It is important to distinguish between domestic and international telecommunications networks. Although a sophisticated international telecommunications network currently links most countries in the world,[2] it is of little value to individual firms in exporting countries unless their domestic systems are also adequate. An international call must not only be transmitted across borders, but it must reach its party within the destination country. A domestic telecommunications "bottleneck" substantially decreases the value of the international network to inbound and outbound callers alike. The analysis presented here treats the international portion of the telecommunications network as exogenous and constant. We focus on the quality of the network as a positive influence on export performance.

It is also important to understand the relationship between telecommunications equipment and telecommunications services. The quality of a country's telecommunications system must ultimately be assessed in terms of the quality of service provided to its customers. However, the ability to obtain a dial tone, the speed with which a call can be completed and the ability to simultaneously transmit data and voice messages all depend on the type of equipment in the network. Therefore, the quality of the equipment corresponds directly to the quality of service; although measures of equipment quality are used in this paper, they are in fact measures of service quality as well.

The quality of a country's telecommunications system can be measured in a number of ways. It is important, however, that such measures capture both access to telecommunications services and the degree of modernization inherent in those services. Expressed differently, a model should reflect both the quantity and quality of telecommunications services.

In this paper, we rely on two measures of network characteristics: (i) lines using electronic switching (ESS), and (ii) number of telephone access lines per 100 population (density). ESS is a quality variable that measures the number of access lines which use solid-state switching devices and computer-like operations to complete calls. The density variable is the most common measure of telecommunications availability.

Since producer services such as management consulting and data processing are information-intensive, and since telecommunications services facilitate the transfer of information, it follows that a country's ability to export services like these are likely to be influenced by the quality of its telecommunications system. However, this relationship is extremely difficult to test empirically. Accurate service trade data are notoriously difficult to obtain, since service exports have traditionally been calculated as a residual in national accounts data. However, service trade data for the U.S. and selected trading partners have been compiled for 1986 and later years. Although these data are by no means complete, they do permit a crude test of the relationship between telecommunications and developing country service exports.

We focus our attention on developing countries. Our sample on trade in services includes 13 countries, while the sample for exports of manufactured goods includes 43 countries.[3] Our data on trade in services are drawn from the Bureau of Economic Analysis' benchmark survey. The benchmark survey covers U.S. exports and imports with 28 countries in 1986 for eleven service sectors. Revisions to this data were published in June 1989 and September 1990 (see Krueger 1989 and DiLullo and Wichard 1990). Utilizing data on U.S. bilateral service flows, we analyze the composition and volume of U.S. trade in services, assessing the role of information intensity and telecommunications network quality in determining the pattern of trade in services.

Aggregate data on exports for each country are from the International Monetary Fund's Direction of Trade Statistics Yearbook. In addition to measures of telecommunications network characteristics, we also expect export performance to depend on income levels and relative country size.[4] Data on population, GDP, and other macroeconomic indicators are from the World Bank's World Development Report. Commodity trade data (on an SITC basis) are from the United Nations.

4. THE RESULTS: SERVICES

While the literature on trade in services has emphasized investment restrictions, the results presented here highlight the role of available telecommunications linkages. Because traded services are often information intensive, the ability to engage in cross-border service transactions depends critically on available telecommunications linkages.

To formally assess this relationship, we have run regressions on 1986 telecommunications and service trade data using the following functional form:

$$\text{Exports} = a_0 + a_1(\text{Density}) + a_2(\text{ESS}) + a_3(\text{Pop}) + a_4(\text{PCY})$$

Soi

where Density and ESS are defined above, Pop is total population, and PCY is per-capita GDP. The dependent variable represents one of the following per-capita export categories: total service exports, "other total" service exports,[5] management consulting and public relations, mining services, advertising and "other" service exports.[6] While there were several additional service categories for which trade with the U.S. was reported in the benchmark survey, the available sample for developing countries was insufficient for any meaningful analysis.[7]

Regressions were run for all service categories for which there were at least 10 observations. An exception was made in the case of "other total" service exports; although there were only 7 observations, this category was judged to be important to the analysis. Consequently, correlation analysis was performed. All results are reported in Table 2.[8]

The results in Table 2 indicate that density and ESS switching are both positive and significant influences on total per capita service exports to the U.S., as well as on per capita exports of mining services. In addition, telecommunications quality appears to play

Table 2

Regression Results:
Per-Capita Service Exports, 1986

	a_0	a_1	a_2	a_3	a_4	Adj. R^2	n
Total Services	-1.85	.33	.38E-05	.97E-02	-.59E-04	.88	10
	-(1.46)	(4.39)	(1.38)	(.87)	-(.13)		
F		17.65	1.43			17.65	
(pr>F)		.025	NA			.005	
Management Consulting	-.15	.01	.37E-06	.90E-03	-.17E-04	.35	10
	-(1.00)	(1.46)	(1.61)	(.59)	-(.39)		
F		2.22	2.5			2.20	
(pr>F)		.25	.25			.25	
Mining	-.17	.20E-01	.91E-06	.19E-02	-.86E-04	.39	13
	-(.86)	(1.76)	(2.71)	(.85)	-(1.38)		
F		3.17	7.33			2.62	
(pr>F)		.25	.05			.25	
Advertising	-.23	.24E-01	.48E-06	.26E-02	-.64E-04	.03	10
	-(1.19)	(1.63)	(1.04)	(1.64)	-(.94)		
F		2.69	2.59			1.06	
(pr>F)		.25	.25			NA	
Other	-.14	-.79E-02	.28E-06	.68E-03	.68E-04	12 .62	12
	-(1.49)	-(1.38)	(1.67)	(.81)	(2.20)		
F		2.63	2.92			5.42	
(pr>F)		.25	.25			.10	
Total Services Excluding telecomm		.93	.78				6

t-ratios are reported in parentheses. F-statistics for the full model are reported in the R^2 column.

a role in explaining exports of management consulting and public relations services, and to have some impact on exports of advertising services. However, the results for the category of "other services" were inconclusive. Correlation analysis between per capita exports of telecommunications-exclusive services and telecommunications network quality yielded strong results as well. Correlation coefficients of .93 and .78 were generated for density and ESS switching, respectively.

To assess the individual influence of telecommunications density and ESS switching on service exports, F statistics for each telecommunications variable are also reported. These are based on partial sums of squares. Telecommunications density contributes significantly to the explanatory power of the empirical model. However, ESS switching does not appear to play as important a role in explaining total service exports. ESS switching is significant for the remaining categories.

The F statistics indicate that both telecommunications density and ESS switching contribute significantly to the explanatory power of the empirical model. The exception is the category of total service exports, where ESS does not contribute significant explanatory power. While the level of significance is quite low in most cases, this may be due to the small sample size.

5. THE RESULTS: TOTAL EXPORTS

Regressions were run using 1986 data for telecommunications and aggregate exports. The same functional form is used as in the analysis of services. Exports are again measure on a per-capita basis. Results are reported in Table 3 for 1986 for our sample of developing countries. The coefficients on both telecommunications density and ESS switching are significant, and have the expected sign. The coefficient on population is negatively signed in both runs, as expected. The coefficient on per-capita income is positively signed, also as expected.

The results suggest that, in the context of the developing countries in our sample, an increase of .01 lines per-capita would yield an increase in exports of $61 per-capita. Similarly, an increase of 5000 ESS switched lines generates an additional $1 of export revenue per person. It is important to note

Table 3

Regression Results:
Per-Capita Total Exports, 1986

	a_0	a_1	a_2	a_3	a_4	Adj. R^2	n
Parameter Estimates	-188.76	61.20	.02E-02	-1.49	.13	.73	43
	-(1.28)	(2.89)	(3.79)	-(.59)	(1.12)		
F		7.6	15.12			29.19	
(pr>F)		.01	.005			.005	

t-ratios are reported in parentheses. F-statistics for the full model are reported in the R^2 column.

that while the incremental contribution of additional investment in telecommunications infrastructure to export revenues may appear to be quite small, these investments typically occur in large increments.

To assess the individual influence of telecommunications density and ESS switching on aggregate exports, F statistics for each telecommunications variable are also reported, based on partial sums of squares of the error terms. Telecommunications density is a significant explanatory variable for LDC exports. The ESS switching variable is also significant. The F statistics indicate that both telecommunications density and ESS switching contribute significantly to the explanatory power of the empirical model. The contribution of the ESS variable is significant at the 99.5% level.

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6. THE RESULTS: HIGH TECHNOLOGY MANUFACTURES

While the results described in Section 5 suggest that telecommunications quality influences export performance, it is unlikely that network quality influences all exports equally. Because telecommunications is postulated to generate greater benefits as production processes become more complex, a strong relationship between network quality and exports of high technology products was expected. Regressions were run using 1986 data for various 4-digit categories of manufactured exports. We continue to use the functional form described in Section 4. Selected results are presented in Table 4.

Table 4

Regression Results:
Per-Capita Manufactured Exports, 1986

	a_0	a_1	a_2	a_3	a_4	Adj. R^2	n
Office machines	-22.35	1.65	6.93E-05	5.81E-02	5.98E-03	.47	29
	(-1.92)	(1.33)	(1.87)	(.37)	(1.03)		
F		1.8	3.73			7.32	
(pr > F)		(.25)	(.10)			(.025)	
Electric power machinery	-9.58	.73	3.83E-05	2.33E-02	2.09E-03	.51	29
	(-1.88)	(1.44)	(2.37)	(.33)	(.83)		
F		2.29	5.71			8.14	
(pr > F)		(.25)	(.05)			(.025)	
Telecom equipment	-20.77	1.49	7.58E-05	4.50E-02	5.71E-03	.65	30
	(-2.58)	(1.78)	(2.83)	(.40)	(1.37)		
F		3.33	9.33			14.39	
(pr > F)		(.25)	(.05)			(.005)	
Automotive electric equipment	-.38	3.84E-02	.17E-05	1.11E-03	8.75E-05	.55	28
	(-1.65)	(1.73)	(2.36)	(.34)	(.77)		
F		2.86	5.71			8.09	
(pr > F)		(.10)	(.05)			(.025)	
Other electrical machinery	-4.42	.30	1.26E-05	1.12E-02	1.58E-03	.53	30
	(-2.08)	(1.35)	(1.77)	(.38)	(1.43)		
F		1.88	3.13			8.19	
(pr > F)		(.25)	(.10)			(.025)	
Accounting machines, computers	-1.78	1.78E-05	.15	-8.47E-03	-3.08	.83	21
	(-1.28)	(3.83)	(1.22)	(-.27)	(-.06)		
F		1.8	14.4			9.40	
(pr > F)		(.25)	(.005)			(.025)	
Aircraft engines	-3.70	1.04E-05	.18	1.17E-02	1.23E-03	.62	20
	(-2.30)	(2.14)	(1.30)	(.89)	(2.00)		
F		6.0	7.5			8.78	
(pr > F)		(.05)	(.025)			(.025)	

As the results above indicate, ESS switching consistently contributes significantly to the explanatory power of the model. Telecommunications density also contributes to the model's explanatory power, but often at a lower level of significance.

7. CONCLUSIONS

In this paper, we have examined the relationship of telecommunications infrastructure to trade in intermediate or producer services. We have also examined the contribution of network quality to export performance in the manufacturing sector. Our results indicate that telecommunications network quality is a significant determinant of the pattern of trade in goods and services.

The quality of telecommunications services does appear to play a role in explaining service export performance across developing countries. However, the paucity of the data makes it difficult to determine whether exports of certain services are more heavily influenced by telecommunications than others. In addition, it is important to note that these data exclude transactions between multinational corporations. Thus the hypothesis that telecommunications facilitates the transfer of headquarters services from parent to subsidiary cannot be tested here. Moreover, these data do not reflect service trade between developing countries or between LDCs and other industrialized countries, but only their comparative advantage in exporting to the U.S.

Telecommunications network quality also appears to influence exports of certain manufactured products. In particular, density and ESS switching emerge as significant influences on exports of high technology manufactured products and producer intermediate goods. Our results suggest that telecommunications quality may play an important role in the ability of Asian exporters like Hong Kong and Singapore to enjoy a comparative advantage in exports of high technology manufactures.

Our results suggest that the contribution of national telecommunications infrastructure to developing country export performance should be considered in telecommunications policy decisions.

NOTES

*This paper represents the opinions of the authors, and is not meant to represent the opinions of the ITC or any of it members.

1. See Motiwalla (1988).

2. The international network is comprised largely of undersea cable as well as communications satellites launched by private firms in the U.S. and other industrialized countries.

3. The list of countries in the services sample include: Argentina, Brazil, Venezuela, Saudi Arabia, Hong Kong, Indonesia, Malaysia, Philippines, Singapore, South Africa, Israel, Mexico and India. The list of countries in the manufactured exports sample included: Ethiopia, Kenya, Liberia, Madagascar, Malawi, Morocco, Senegal, Sierra Leone, South Africa, Sudan, Tanzania, Zambia, Hong Kong, Indonesia, Korea, Malaysia, Pakistan, Papua New Guinea, Philippines, Singapore, Thailand, Greece, Hungary, Portugal, Turkey, Yugoslavia, Israel, Oman, Saudi Arabia, United Arab Emirates, Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Trinidad and Tobago, Uruguay and Venezuela.

4. In the empirical trade literature, models of this type are known as gravity models. The recent theoretical literature on trade with product differentiation and imperfect competition provides a theoretical basis for expecting this relationship between trade, income levels, and relative country size. (Helpman and Krugman, 1985).

5. "other total" represents total service exports less telecommunications service exports.

6. "other" service exports include agricultural, health management, accounting, educational, mailing and reproduction, personnel supply, and sports and performing arts.

7. These categories included: computer and data processing, database and information services, R&D and testing, legal services, industrial engineering, industrial maintenance and repair, and primary insurance. These categories contained either exclusively "0" observations for developing countries, or so few positive observations that the analysis was meaningless.

8. Highly suggestive, suggestive and poor results are reported together in Table 10. Note that the density and ESS coefficients reported for "other total" service exports represent correlation results, not regression results.

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Telecommunications Standards and Asia/Pacific Trade

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Abstract

One essential infrastructure needed for the advancement of trade in the Asia/Pacific region is telecommunications. Telecommunications networks rely on use of global, regional and national standards for their implementation. It is significant that there is no regional telecommunications standards body in the Asia/Pacific region equivalent to those in Europe or North America.

Inherent in the telecommunications business is the matter of standards. Standards represent specifications for a wide variety of different technical details: the way different pieces of equipment will operate; how they will interconnect with each other; how the frequency spectrum will be used; how electronic messages between different systems will be formatted; how billing information will be collected and formatted; how signals will be encoded or multiplexed; what transmission levels are acceptable; etc. In fact, almost every facet of telecommunications networks are or can be covered by standards.

Some examples of standards are the basic Pulse Code Modulation (PCM) standard for digital voice; the sophisticated CCITT Signaling System Number 7; and the standards related to the Integrated Services Digital Network.

Standards are the enablers for the interconnection of telecommunication networks. This interconnection is what allows the free flow of information which today is fundamental for international trade. It is not an exaggeration to say that the volume of trade today would be impossible to support without excellent national, regional and global telecommunications.

Therefore, it is fair to say that telecommunication standards have played a tremendous role in the development of the world economy today.

If one were to start with a completely blank slate concerning a telecommunications network, it would be possible to develop all specifications for such a network with no reference at all to any other specifications or standards.

One could establish a different encoding scheme for digital voice. One could develop a completely new and different signaling scheme for establishing connections between different switching systems in the network. One could even decide to use a broader or narrower bandwidth or bit rate for the messages to be carried on the network.

Such a self-contained network could then be built to these new and different specifications, and it probably could provide good telecommunications service, although much testing and debugging would undoubtedly be needed.

However, when the owner of a network built to such completely new and different specifications attempted to interconnect this network to other networks, problems of incompatibility would arise. As a minimum, there would need to be all manner of converters to adapt the interfaces between the networks. In the worst case, communications might be so degraded as to be impossible.

The reality, of course, is that network operators do not generate all new specifications covering all technical matters related to their networks. From the perspective of the network owner, the cost of developing and verifying all technical specifications would be extremely high. From the perspective of equipment manufacturers, it would be extremely costly to have to produce equipment to a wide and unpredictable range of specifications.

Instead, network operators use a combination of accepted international standards together with suitable local specifications to define their network requirements. This permits equipment manufacturers to manufacture a smaller range of equipment, thus keeping the price down.

The standards which have emerged today are the result of a complicated process involving telecommunications users, telecommunication carriers and administrations, and telecommunication equipment suppliers. There is discussion, debate, disagreement and finally, compromise. The ultimate objective is to maximize, to the extent possible, the benefits of each specific standard to all the players.

The benefits of telecommunication standards to users includes lower prices, better quality and ubiquitous service. The benefit of telecommunication standards to carriers and administrations include simpler design of networks; better quality and lower priced products due to supplier competition; and much simpler interconnection with other carriers and administrations. Suppliers of telecommunications equipment benefit from being able to address a much larger market with their products, and reduced cost of research and development to adapt their products to different markets.

Messaging Handling Systems provide an excellent example of the way in which all players benefit from standards. Thirteen years ago, many proprietary text messaging systems had been developed, and almost none of them could talk to each other. This presented a fragmented market too small for most suppliers to address efficiently and did not represent a good business for them. Users were frustrated with their inability to communicate with other users. And carriers could not get quality products to offer the service. With the adoption of the 1984 and 1988 versions of the CCITT X.400 series of Message Handling recommendations, a global market for text messaging is rapidly emerging.

As it happens, standards in telecommunications are established at three distinct levels--global, regional and national.

Organizations such as ISO, CCITT, and the IEEE develop global recommendations which are used throughout the world. At this level, the setting of standards can become a highly political process. For example, some nations have accused other nations of using standards as a non-tariff trade barrier.

Because of such political considerations, and because full agreement among all interested parties on a voluntary basis is difficult to achieve, global standards often contain a large number of permitted variations or options. While the options are required politically, they slow the development of products, since manufacturers must wait for each network operator to reach a decision on which options will be included in his particular network.

To address this issue, regional standards organizations have emerged to allow groups of countries to make the choices of options among a smaller number of players. This also allows the groups of countries to develop a regional position, and thus have a single strong bargaining voice in CCITT and other global

standards forums. This process provides hard standards which suppliers know will be frozen for a sufficient time to allow them to get a reasonable return on investment in development of new products.

Two major regional standards bodies include the European Telecommunications Standards Institute (ETSI) and the Exchange Carriers Standards Association (ECSA), which are rapidly agreeing upon European and North American telecommunication standards. The resources of these regional groups include some paid workers and a much larger number of volunteers, e.g. from telecommunications suppliers, to speed the process.

The ultimate results of this regional standards work will be telecommunications network offerings in these regions which will offer advanced capabilities on a seamless basis across various networks.

It is significant that there is no regional body in the Asia/Pacific region equivalent to ETSI or ECSA.

Economic growth forecasts for Asia/Pacific are very optimistic. And major economic growth will clearly require major growth in telecommunications as a basic infrastructure supporting business of all kinds.

But, without well-defined and agreed to regional standards, telecommunication networks in Asia/Pacific countries will continue to be fragmented, with individual countries and individual network operators using a wide mixture of various global, regional and/or national standards. To some extent, this results in de facto standards to be used which may or may not be in the best interest of a given country or of the entire region.

A well defined set of standards, tailored to the Asian business environment will foster cooperation, and improve productivity throughout the region. Users and nations will benefit since it will be simpler to offer new advanced services across multiple networks. Such standards will make it easier for telecommunication equipment suppliers to develop products tailored to the Asia/Pacific market, by enabling them to address this market as a group, instead of having to adapt products to the large number of national variations which currently exist in the region.

Regional standards will also encourage development of a wider range of Asian products. Because of the larger market which will emerge across Asia, products which are currently not feasible, because of a limited market, will become more attractive. And the process of developing regional standards will include development of well defined interfaces to allow interworking with the North American and European standards, which will benefit all the stakeholders.

It should also be recognized that the CCITT has set forth proposals to regionalize or decentralize standards setting. This will only work in Asia/Pacific if there is a regional standards setting body.

It is strongly suggested now is the time for the Asia/Pacific region to begin developing its own standards harmonization program.

RELATIONSHIPS BETWEEN JAPAN, EUROPE AND THE USA

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1. ABSTRACT
Telecom services and equipments represent important markets, but above all a strategic piece of the international relationships, particularly fort the three big regional entities : Japan, USA and Europe.
This paper tries to present the present positions between operators and equipment providers, the trends relating to the regulation context and the state within the GATS (GATT) negociations.

2. Introduction
3. Analyse of the positions in the manufacture activity
4. Situation of the operators and their networks
5. The reglementation evolution
6. The stake of the GATT

FIGURES

(1) Institut de l'Audiovisuel et des Télécommunications en Europe
BP 4167 - F-34092 MONTPELLIER Cedex 5
Tel. : 33/67.14.44.14 - Fax : 33/67.14.44.00

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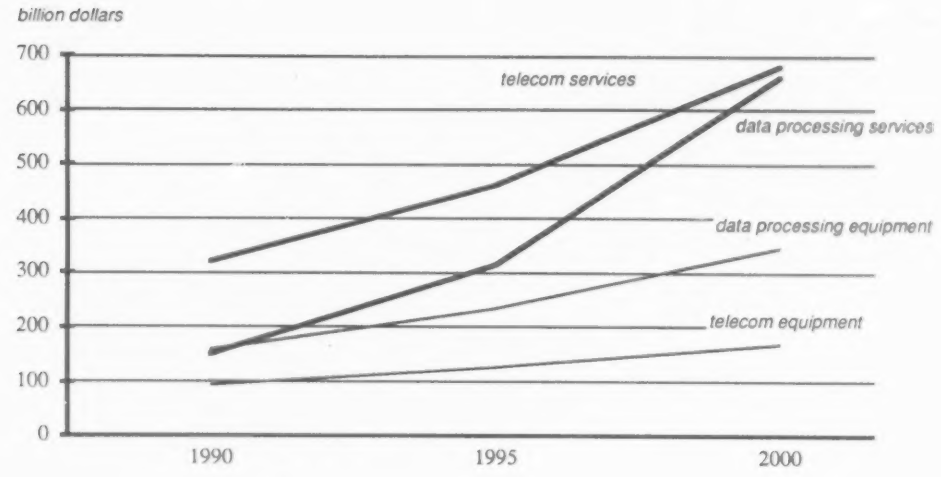
FIGURES

I. The manufacture activity is developing less quickly than services

Telecommunications and information technology : markets drawn by services
Development of world markets

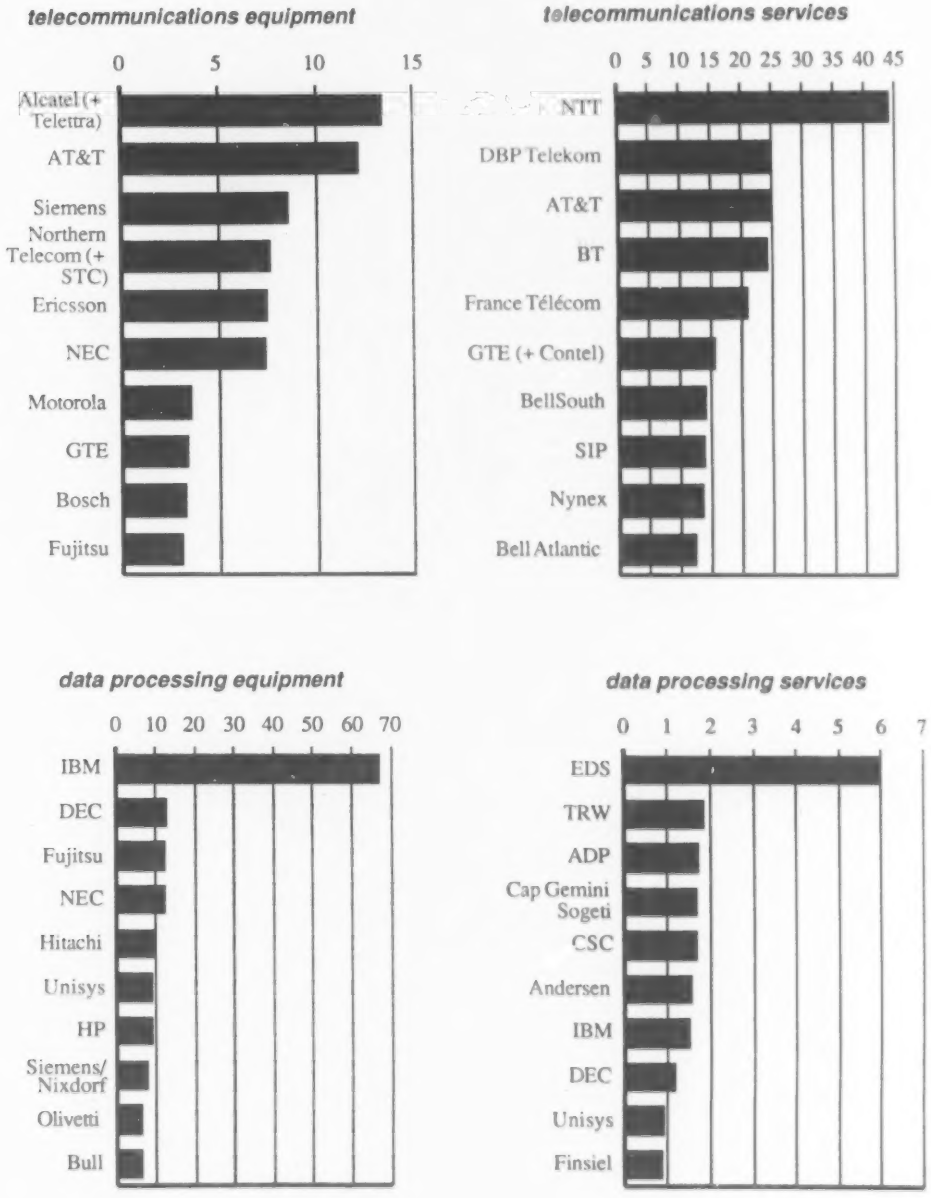


Data : IDATE industrial analyses

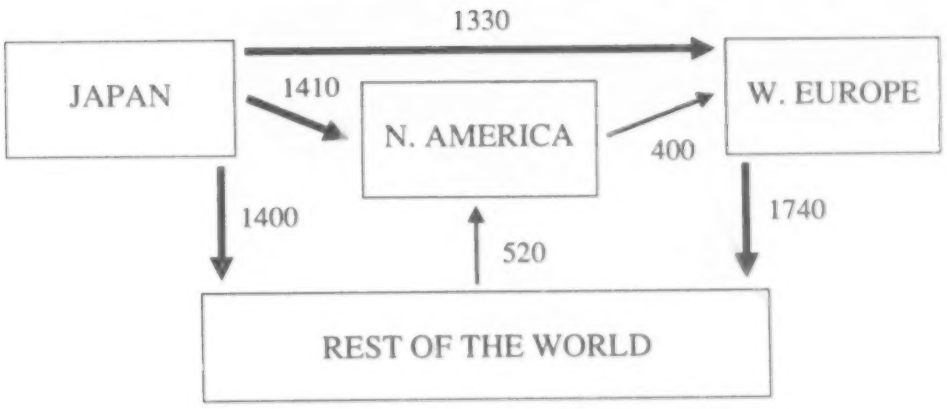
FIGURES

II. Telecommunications (equipment and services) remain one of the Europeans' major advantages

World leaders
(1990 pro forma results, in billion dollars)



III. TRADE BALANCES (Telecom equipments)



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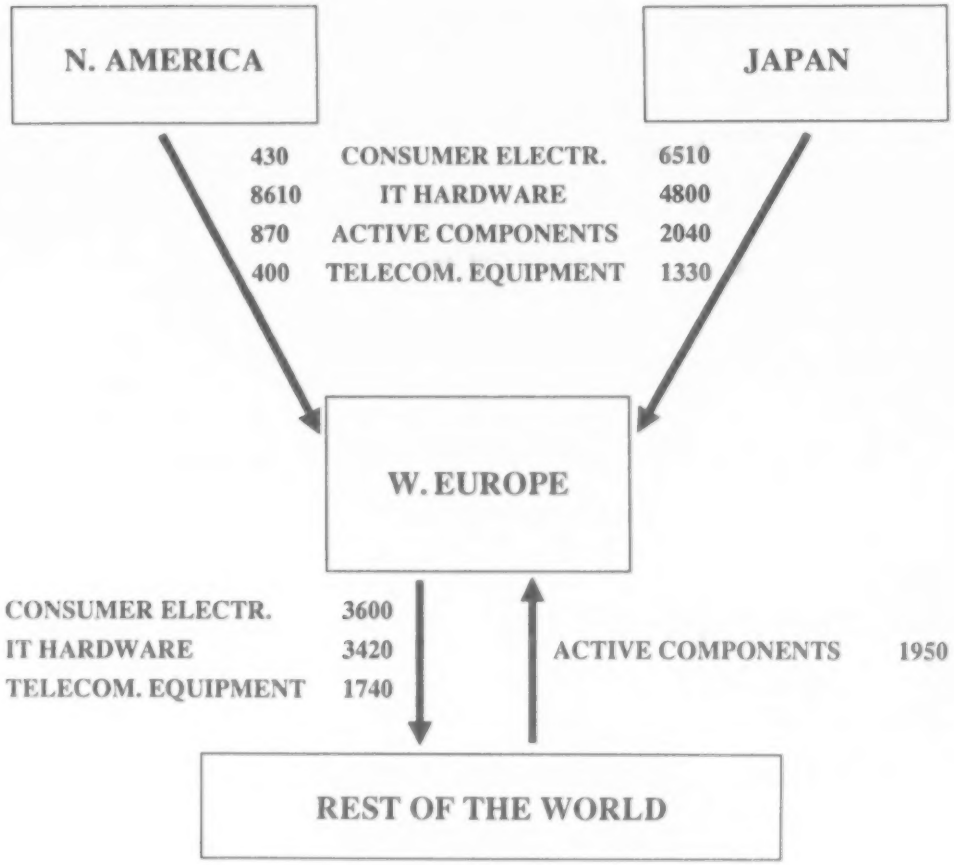
TRADE BALANCES IN THE ELECTRONIC SECTORS

The European position

(figures in bn $)



GROSS BALANCES :

CONSUMER ELECTRONICS	-3340
IT HARDWARE	-9990
ACTIVE COMPONENTS	-4860
TELECOM. EQUIPMENT	+10

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IV. OPERATORS : TOP 10 and network digitilization rates

TELECOM SERVICES

TOP 10

	turnover (bn $)	access lines (000')	debt ratio (1)	capital exp. (bn $)
NTT	44.2	54.1	37.6	11.5
DBT	25.1	30.2	na	11.4
AT&T	25.1	-	31.8	3.6
BT	24.3	25.5	28.4	5.1
FT	21.1	28.1	na	6.1
GTE (incl. Contel)	15.8	18.4	na	4.2
BellSouth	14.3	17.5	30.0	3.2
SIP	14.0	22.4	53.5	8.1
Nynex	13.6	15.3	32.8	2.5
Bell Atlantic	12.3	17.5	37.1	2.5

(1) L&MT debt/LT liabilities

NETWORK DIGITIZATION RATES

(as % of local lines)

W. Europe		N. America		Japan	
FT (F)	72.6	BllSth	51.2	NTT	39.0
BT (UK)	46.9	PacTel	35.5		
SIP (I)	33.1	GTE	74.0		

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FIGURES

V. INTERNATIONAL TRAFFIC....

- About 2 % of the traffic volume
  10 % of the operators revenues

- TOP 25 : Traffic base of the world's major international carriers

Carrier	Outgoing MITT in millions	Carrier	Outgoing MITT in millions
ATT	5780	Swedish Telekom	815
DBP Telkom	3146	Telefonica	611
BT	2170	Saudi Communic. Ministry	590
France Télécom	1921	US Sprint	577
Telecom Canada	1420	Teleglobe Canada	565
Swiss PTT	1356	Austrian PTT	559
Cable & Wireless	1291	China PTT	460
MCI	1132	Telmex	421
Italcabla/ASST	1045	Danish PTT	363
PTT Telecom Netherlands	905	Norwegian Tlecom	281
KDD	764	Telecom Eireann	263
RTT	731	UAE Comm. Ministry	248
OTC	620		

SOURCE : International Institute of Communications

... AND TARIFFS

Intra-European versus US-Europe accounting rates

County	Intra-European rates	US-Europe rates
Austria	$0.58	$1.44
Belgium	$0.43	$1.57
Czechoslovakia	$0.48	$1.62
Denmark	$0.48	$1.31
Finland	$0.58	$1.31
France	$0.45	$1.45
Germany	$0.48	$1.57
Greece	$0.72	$2.14
Hungary	$0.54	$1.70
Italy	$0.55	$1.94
Netherlands	$0.43	$1.44
Poland	$0.55	$1.50
Spain	$0.55	$1.97
Sweden	$0.54	$1.05
Switzerland	$0.46	$1.47
United Kingdom	$0.48	$1.00
Yugoslavia	$0.64	$1.79

Source : US FCC

BRINGING UNIVERSAL ISDN SERVICE TO REALITY !

Dale T. Rogers, AT&T Network Systems
Jerry Nowicki, ESI Systems, Int'l.
Takeshi Kawauchi, NTT
Osamu Inoue, NTT

1.0 ABSTRACT

Integrated Services Digital Network (ISDN) applications have now spread through out much of the industrialized world, though not as rapidly as the telecommunications industry had originally expected. However, last year several equipment and service providers in the U.S. and other countries began to actively partner with each other to proactively expand international ISDN service. In response to multinational customers, these providers pooled their resources and developed a series of Basic Rate (BRI) ISDN applications demonstrations. This then led to collaboration to provision ISDN applications for several new commercial customers between the U.S. and Japan.

While such cooperative efforts are truly noteworthy, they are only the beginning. Building upon these successes, the cooperation must continue and it is now time for the industry to do more to assure that ***ISDN services become UNIVERSALLY available***. Telecommunication service and equipment providers must now make a concerted effort, both individually and as an industry to completely topple the remaining technical, regulatory, financial and educational barriers that hold back the deployment of ***UNIVERSAL ISDN***. Today, more than ever, there is a need to shift from informal industry coopetation to stronger and more committed partnerships in order to forge the proper ISDN application sets for specific customers and industries. (1)

2.0 GLOBAL ISDN ENVIRONMENT

UNIVERSAL ISDN services have certainly been the vision of the telecommunications industry since the concept was formulated by CCITT many years ago. Since that time, those who believe in, and have participated in this vision have experienced both the initial euphoria surrounding this next generation "technological revolution" and the reality of implementing this "standardized" vision. However, recently the telecommunications industry has entered a new more "customer focused" phase. This more mature phase, which blends futuristic vision with technological and human factor realities to achieve actual customer application needs, is proving to be the right formula for success.

What does success mean? Well, probably not 100% deployment and usage throughout the industrialized world as once envisioned. This view is unrealistic in todays world of vast technological choices and competitive service market place. ***However, ISDN will be a dominant factor in the now rapidly emerging world of public switched data and data related communications***. After several years of evolving this new integrated type of technology, the industry is realizing that if it can match its available technology with customers communication needs, then ISDN will easily fulfill the rapidly growing market needs for world wide integrated data communications via the public switched network. Recent industry studies project over 4.5 million ISDN equivalent lines by 1995 (figure 1). In Europe, the

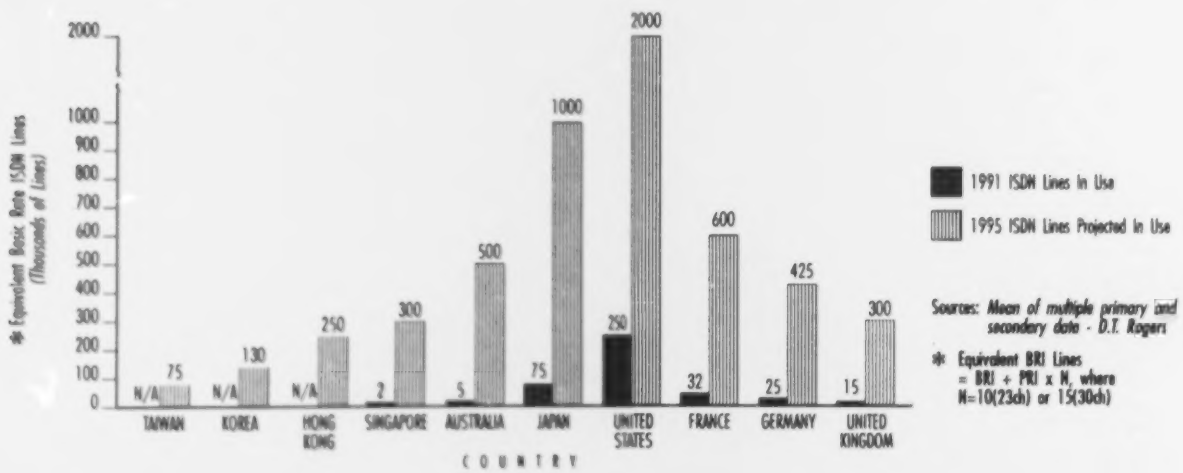

Figure 1
Global ISDN Line In Use - Selected Countries

ISDN market is expected to take a firm hold during the 1993-96 time frame and projected to capture as much as 22% of the data connection traffic in Western Europe. (2) The growing interest in image and videoconferencing applications will further expand the use of integrated data at an even more rapid rate. For instance, a PictureTel Corporation spokesperson projects that Basic Rate (BRI) ISDN will essentially capture as much as 90% of the low-band-width (56kbs - 128kbs) videoconferencing market by 1995. (3)

Integrated data ISDN applications are especially suited for small and medium business markets as well as residental work at home applications which have been previously limited to communicating via low speed modems over the existing analog switched public networks. ISDN is particularly attractive for these customers since it provides ease of access and use, and lower overall costs. This represents a sensible alternative for this huge customer base as compared to the costly dedicated private network solution. The strong customer interest in dial-up ISDN video conferencing today and the subsequent price/value advances being made are one area that customers are going to benefit. Additionally, the experience that the industry has gained by the successful implementation of N-ISDN service applications is proving to be invaluable to the growing number of industry players as they begin to plan for the next stage of ISDN, --- broad band service. Experience shows that while theoretically it may be possible to leapfrog from one technology to the next, in practicality it is almost impossible due to various economical, regulatory, and just plain sociological human factor considerations.

Some of the key factors that now contribute to the ability of ISDN to meet many customer needs are;

- Widespread ISDN switch availability,
- Circuit and packet switched network connectivity,
- Increased choices of affordable CPE,
- Realistic and affordable tariffs,
- Informal industry partnerships,
- PTT marketing and ISDN sales incentives,
- Increasingly sophisticated customer base,
- Decentralization of major corporations and public infrastructures.

Once these basic factors are addressed by the respective parties, there is a high confidence level that the PTT's customer growth rates will be in the range of 200 -300% per year for the first few years, attaining approximately a 1 - 3% penetration of the total customer base. Much further market penetration is expected as customers become more comfortable and familiar with lower cost tariffed ISDN services for integrated data applications. For example, NTT expects that 20 - 30% of their business customers will be using ISDN by 1996.

Critical to the marketing successes though is the importance and availability of low cost and easy to use customer premise equipment (CPE) which is now readily apparent as part of the ISDN equation. Japanese manufacturers recognizing this huge potential market have now created over 200 models of ISDN CPE with prices planned to start as low as Y29,800 (~$225 US) for the yet untapped residential market. In the U.S., manufacturers are also beginning to provide many ISDN CPE options to end customers. A recent edition of Network World noted at least 50 different models available in the U.S. mainly targeted for data and business usage (4).

3.0 U.S. - JAPAN COOPERATION

In 1989, AT&T, Nippon Telegraph & Telephone (NTT), Pacific Bell and Kokusai Denshin Denwa (KDD) established a long-term partnership to provide ISDN services for mutual customers in Japan and California. (5) The initial ***focus*** of the relationship was not on the partnership itself, but rather ***on the customers***. Thus, the set of customer needs became the major subject of discussion and subsequent work plan. It was clear from the beginning that the technological, regulatory, investment and marketing issues would be influenced greatly by the kinds of applications that multinational customers wanted.

A process was proposed by NTT which outlined a phased approach to meet the customer needs, while evaluating each steps success along the way.

- X DAY - ISDN application end-to-end network testing, tariff effective
- Y DAY - end to end customer demonstrations and, initial customer offerings
- Z DAY - joint expansion of commercial service

This approach gave all the parties ample time to address the respective barriers they needed to overcome in order to assure a successful process. Since agreement and execution on the process was successfully accomplished, further progress is now being focused on future applications, sharing of target customers, and cooperative marketing initiatives.

The next steps in the process are to utilize the model to expand the cooperation between other U.S. local exchange carriers (LEC's) and Japan. For instance, an agreement has now been reached between NTT and BellSouth to support ISDN services through AT&T and its correspondent KDD, between their respective customers. Preparations were recently completed in November, 1991, to offer the first commercial ISDN service applications between customer locations in Japan and Atlanta, Georgia. Future plans include expanding the NTT and AT&T relationship to all of the U.S. LEC's based on their interest in supporting multinational customer needs. (6) Similarly, partnership efforts are being developed with ISDN-ready PTT's within the Pacific Rim and Europe. One example of California customer benefiting from this concept is Meridian Systems, San Jose, Ca. Their worldwide multimedia conferencing ISDN network is depicted in figure 2.

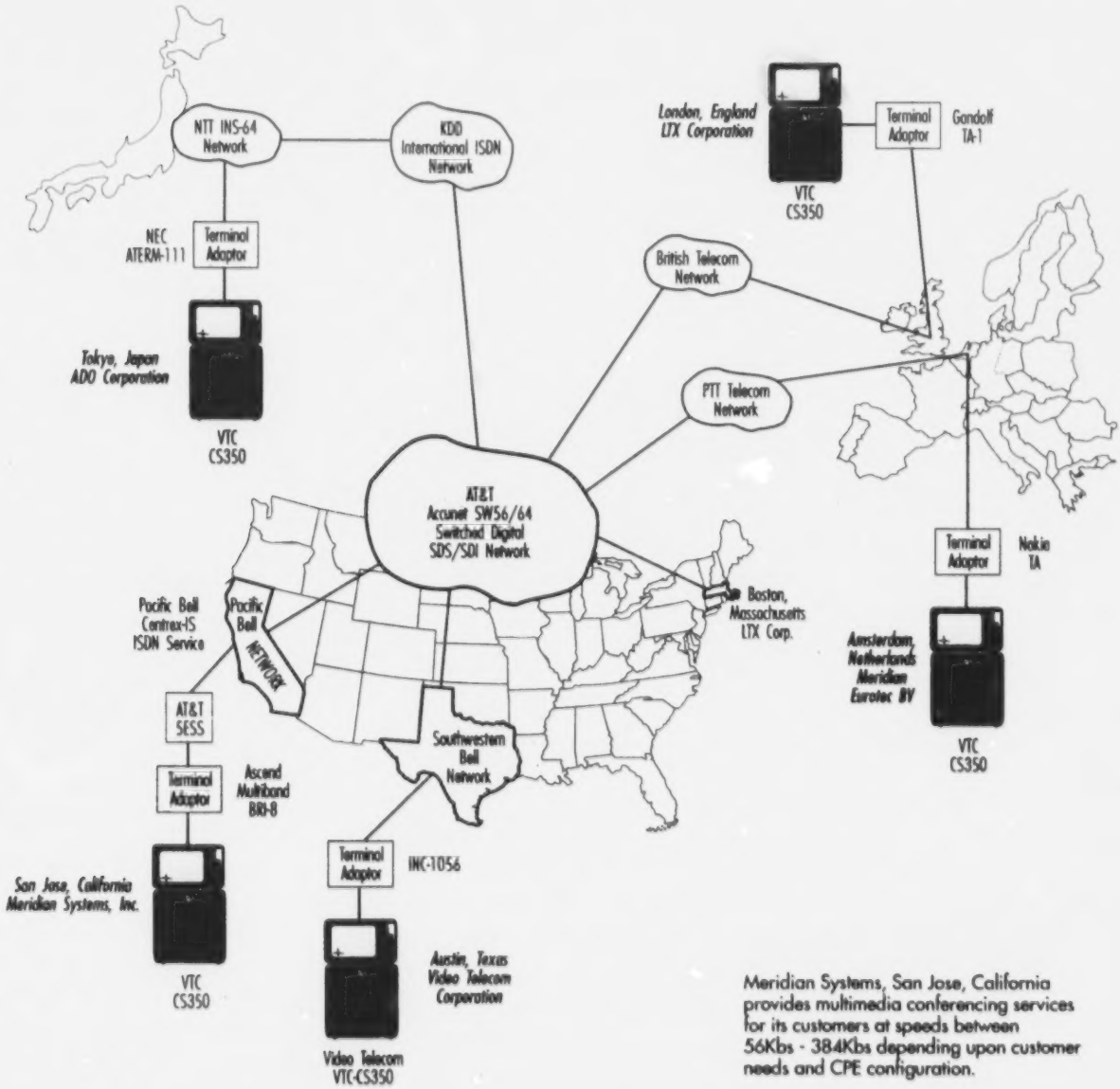

Figure 2
Meridian Systems ISDN Network

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As a commitment to the concept of ***UNIVERSAL ISDN***, AT&T has put a team in place to facilitate the formulation of partnerships which will support additional international customers who want publicly accessed ISDN services. Notably, NTT has successfully achieved agreements with British Telecom, France Telecom, Deutsche Bundespost. These agreements establish specific ISDN applications and the respective manufacturers which will support customers in these locations. This activity combined with the ***NATIONAL ISDN*** efforts being launched in the U.S. will bring us closer to Universal ISDN services. (7, 8)

4.0 CONSTRUCTIVE PARTNERSHIPS

There are some individuals and organizations in our industry who believe that industry cooperation is all that is needed to assure successful deployment of ISDN or any other new technology. However, our experience suggests that the cooperation is not enough. Constructive partnerships wherein each partner's self interests are safeguarded appear to be the best solution. The most obvious benefit comes from the learning achieved by partners in terms of their differing approaches to their respective customer sets. Given the various options available to build applications, the partners can then focus on the critical elements needed to achieve the best price performance. These elements include:

- Network connectivity
- Terminal interoperability
- Terminal pricing
- Customer needs

One of the keys to success is to develop agreements on ways to optimize the applications for the benefit of all. This is truly when the customers receive the most benefit. The partnerships become the catalyst or change agent for resolving many of the critical elements needed for success. Once resolved, ISDN applications then become user friendly and properly positioned to meet pent up demand.

For example, to assist partners in addressing customer needs between California and Japan, an ever growing universal application set can be easily referenced by respective sales account executives to meet their customers needs (figure 3). In addition, sales brochures have been developed which

JAPAN ⟷ CALIFORNIA

	AVAILABILITY / COMPATIBILITY			
APPLICATION	NTT	KDD	PACIFIC BELL	AT&T
Video - Conferencing 112/128 Kbs	Y	Y	Y	Y
G4 Facsimile	Y	Y	Y	Y
Data File Transfer	Y	Y	Y	Y
Still Image Transmission	Y	Y	Y	Y
Video Phone	Y	Y	Y	Y
Hi-Fi Audio	Y	Y	Y	Y
Hi-Fi/Stereo Broadcast	Y	Y	*	*
Image Data Base	Y	Y	*	*
CAD/CAM	Y	Y	*	Y
POS Data Transmission	Y	*	*	*
Floppy Disc Transfer	Y	Y	*	Y

Y = Tested
* = Not Tested Yet

Figure 3
Global ISDN Application Compatability

provide meaningful information about how an application works, the benefits, and the initial start up costs (figure 4). NTT has developed similar sales material (figure 5) and has built a comprehensive list of the ISDN applications that are supported through their partnering arrangements. This ready referenced applications guide includes a list of terminals by all known manufacturer that readily connect to NTT's ISDN service in Japan. All of these efforts are designed to make it easier for customers to take advantage of locally accessed public switched ISDN applications.

Figure 4
Pacific Bell
ISDN Application Salesware

5.0 PACIFIC RIM VISION

There are many people inside and outside this industry that see the 21st century as the "Age of Telecommunications". This is primarily driven by what Haruo Yamaguchi, Chairman of NTT, describes in his recent book as, "kōdō jōhōka", which essentially means, the ***steady rise in the degree of informatization***. (9) Obviously, ***UNIVERSAL ISDN*** will play an important part in this new telecommunications era and the Pacific Rim is moving rapidly to bring the vision to reality. Perhaps the most important factors to assure this goal are the following.

- Widespread public acceptance
- Industry, customer involvement
- Building broad based applications

One of the major drivers in gaining widespread public acceptance is to assure that ISDN is easy to order and easy to use. The second but just as important driver, is to keep public access inexpensive. This translates not only into inexpensively tariffed access rates but also reasonably priced customer terminal equipment. The Pacific Rim industry players can assume an important leadership role in influencing this direction.

The customer-industry involvement is best described as tightening the linkage between customers and industry players in industry sponsored forums to assure that customer needs are well understood and that agreement can be reached on how these needs can be addressed.

Lastly, building broad based applications simply means that services need to be designed which not only benefit businesses but also enrich our every day lives. In the future, society will require a balance of the needs for material goods and services with the intrinsic values of family and mental well being. This is clearly the challenge for the 21st century and the Pacific Rim can play an important part in bringing this vision to reality.

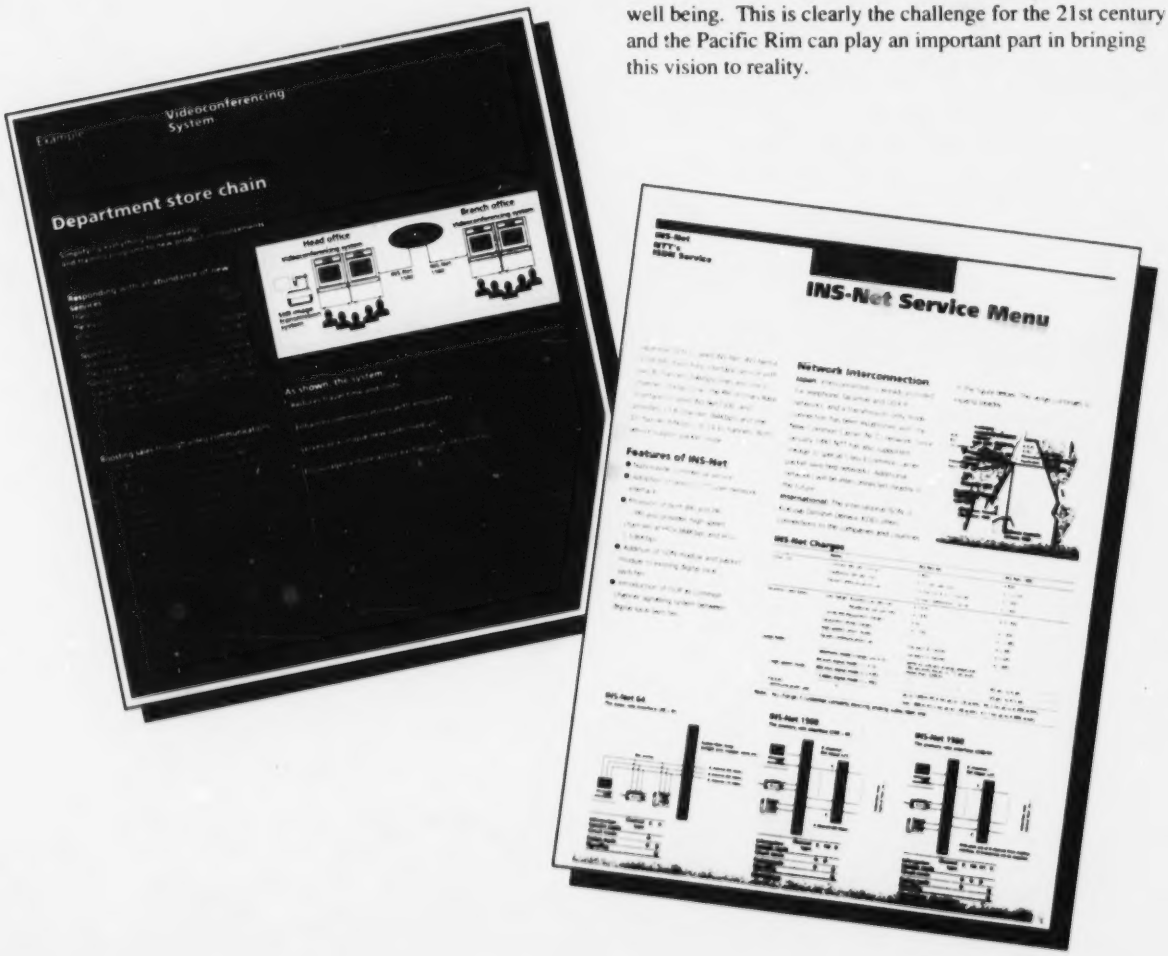

Figure 5
NTT
ISDN Application Salesware

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NTT's ISDN "INS-Net" and Customer interest in Global ISDN

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1 ABSTRACT

ISDN is the wave of the future. It will revolutionize the field of communication as we now know it, starting in the workplace and then following with changes at all levels of society. The result will be a dramatic reduction in the time required to communicate all types of information as well as an increase in applications impossible with conventional technology. In short, ISDN is a tremendous innovation that promises to bring about immense changes in our work, lifestyles and society.

Internationalization is already sweeping the globe, expanding the movements of people and goods. Economic coalitions are superceding national boundaries; nations are becoming more and more interdependent. Only by working together in a worldwide effort will we be able to solve our most pressing problems. But in order to work together effectively, nations must consider not only what is best for themselves but for the world as a whole.

Technology is the driving force behind globalization, and the role of telecommunications has been particularly great. Yet just as telecommunications encourage globalization, globalization itself fosters the need for a standard, worldwide communications system.

ISDN is destined to play a major role in linking the world in the forthcoming "Era of Globalization".

Today, customers' needs are going beyond the nationwide availability of NTT's ISDN services, "INS-Net", in Japan. Customers' needs to use ISDN worldwide are increasing day by day because of its cost effectiveness and new value-added applications.
In order to cultivate customers'needs for global ISDN, NTT has been making efforts to make them realize the advantages of global ISDN especially by demonstrating some actual applications of global ISDN between Japan and several other countries in the exhibit "NTT collection'90". The demonstration attracted a lot of of visitors and they showed keen interests in global ISDN. Moved by the demonstration, many visitors, who had had no chance to experience global ISDN directly, made a decision to introduce INS-Net to utilize global ISDN.

Today, INS-Net customers can take advantage of ISDN service between Japan and and 11 other countries such as the U.S.,U.K. and France. There are some barriers based on the technical differences among each country's ISDN. For instance, it is not so easy to utilize the ISDN interconnection between Japan and the U.S. because of the difference in the transmission speed of ISDN between two countries. In order to promote global ISDN at least, these problems have to be solved.

NTT believes that to promote global ISDN helps not only promote INS-Net in Japan but also promote ISDN service in every other country. NTT hopes that the day will come soon when peoples all over the world are connected by ISDN.

2 PRESENT STATUS OF NTT'S ISDN SERVICE, CALLED "INS-Net"

2.1 IMPLEMENTATION SCHEDULE OF NTT'S COMMERCIAL ISDN SERVICES CALLED "INS-Net" SERVICES BASED ON CCITT BLUE BOOK (1988)

Apr.1988 Service-start of BRI "INS-Net 64" (circuit switching mode)

Jun.1989 Service-start of PRI "INS-Net 1500" (circuit switching mode) [H0 ch (384kb/s) and H11 ch (1,536kb/s of INS-Net 1500 were inaugurated at the same time and NTT is the only one offering those channels in the world.]

Jun.1990 Service-start of packet switching mode called INS-P, both in INS-Net 64 and INS-Net 1500 (Figure 1)

NTT's ISDN implementation schedule

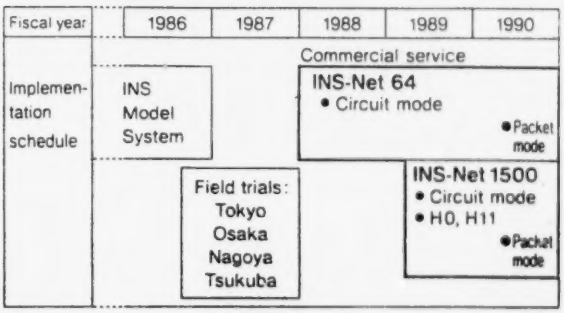

Figure 1 NTT

2.2 NUMBER OF INS-Net SUBSCRIBER LINES (CUSTOMERS), ETC.

(1) NUMBER OF INS-Net SERVICE AREAS AND SUBSCRIBER LINES (CUSTOMERS) (Figure 2)

Number of INS-Net Service Areas and Subscriber Lines (as of the end of Oct. 1991)

Services	No. of subscriber lines (customers)	Service areas
INS-Net 64 [INS-P]	57,808 lines (11,320 customers) [17,267 lines]	1,496
INS-Net 1500 [H0 and H11 chs] [INS-P]	1,082 lines (427 customers) [326 lines] [32 lines]	

Figure 2 Note 1 [ ] : counted again

(2) MOVEMENT OF INS-Net (Figure 3,4,5)

Movement of INS-Net 64

	4/88	9/88	3/89	9/89	3/90	9/90	3/91	9/91
Monthly increase	110	160	170	350	840	1,510	3,510	5,000
No. of lines	110	540	1,200	2,700	6,600	13,000	27,300	52,400
No. of customers	30	100	240	530	1,150	2,900	6,010	10,320
No. of INS-P(*)	—	—	—	—	—	670	4,410	13,620

Figure 3 Note 2 (*) : counted again

Movement of INS-Net 1500

	6/89	9/89	3/90	9/90	3/91	9/91
Monthly increase	20	10	20	30	72	101
No. of lines	20	50	120	260	560	1,010
No. of customers	10	15	30	90	209	377
No. of H0 & H1 (*)	10	15	45	140	219	314
No. of INS-P (*)	—	—	—	13	24	33

Note 2 (*) : counted again

Figure 4

Increase in INS-Net Subscriber Lines

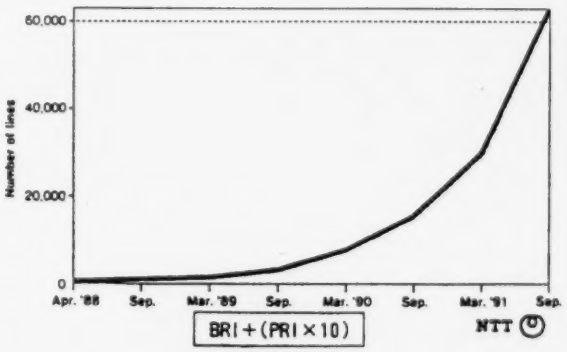

Figure 5

2.3 FUTURE PROSPECTS OF NTT'S ISDN SERVICE

(1) SALES GOAL OF INS-Net

About 750,000 of INS-Net 64 lines by fiscal 1994
About 20,000 of INS-Net 1500 lines by fiscal 1994
(Figure 6)

Growth of ISDN Subscribers in NTT

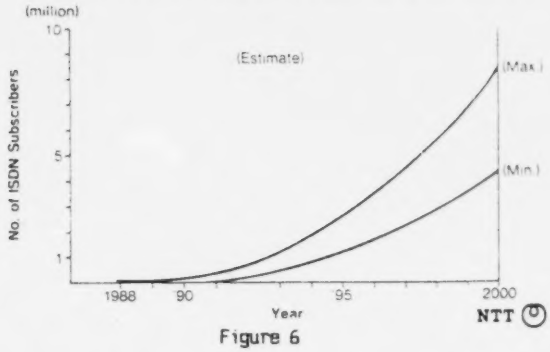

Figure 6

(2) EXPANSION OF SERVICE AREAS

By the end of March 1992, service areas will be expanded to about 2,120, including more than 95% of the nation's cities. (Figure 7)

INS-Net Service Area

(Oct. 1991)

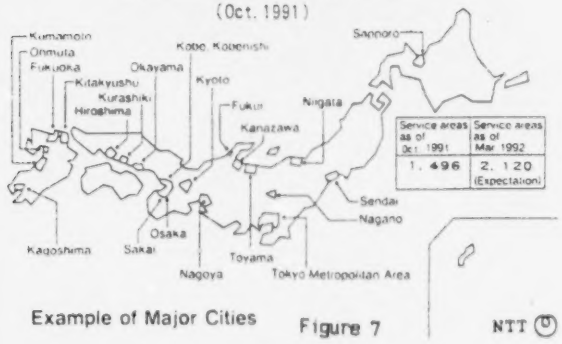

Figure 7

3 PRESENT STATUS OF GLOBAL ISDN

With the globalization of economy, the means of global telecommunication has become one of the most important factor in corporate management. And INS-Net customers' needs to use ISDN between Japan and overseas countries have rose day by day. In this situation, interconnection of ISDN between Japan and overseas countries has progressed under the collabolation of telecommunication carriers in the world.

INS-Net was linked with KDD (Japan's international common carrier) in October 1989, making commercial international ISDN services available for the first time. KDD's commercial international ISDN services now connect Japan with 11 other countries including the U.S., the U.K., France, Singapore, Australia, Italy, Germany, Hong Kong, and Belgium etc. So, today, INS-Net customers can take advantage of ISDN service between Japan and 11 other countries. (Figure 8)

Global ISDN

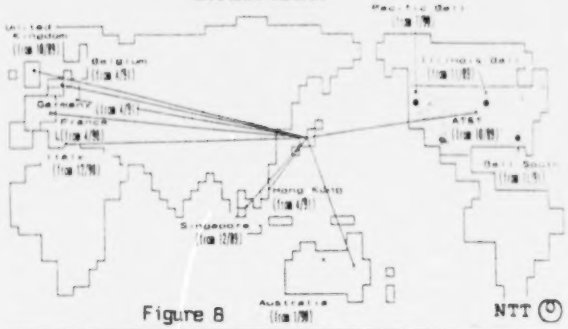

Figure 8

Oct. 1989	○U.S. (AT&T) and U.K. (British Telecom)
Nov. 1989	○U.S. (Illinois Bell)
	○Start of service for the first customer, Andersen Consulting, using the link between NTT's INS-Net, KDD's ISDN, AT&T's ISDN, and Illinois Bell's public ISDN
Dec. 1989	○Singapore (Singapore Telecom)
Jan. 1990	○Australia (Telecom Australia)
Mar. 1990	○Start of service for the first customer, FN Tokyo, using the link between NTT's INS-Net, KDD's ISDN, and BT's IDA service
Apr. 1990	○France (France Telecom)
Jun. 1990	○Start of service for the first customers, Canon and Wagons-lits Tourisme, using the link between NTT's INS-Net, KDD's ISDN, and FT's NUMERIS
Jul. 1990	○U.S.(Pacific Bell)
Aug. 1990	○Start of service for the first customers, Sony, CLI, Ricon, and Tekelec, using the link between NTT's INS-Net, KDD's ISDN, AT&T's ISDN, and Pacific Bell's Centrex-IS.
Dec. 1990	○Italy (Italcable's 64 kb/s digital circuit-switched network)
Apr. 1991	○Germany (Deutsche Bundespost Telekom's ISDN)
Apr. 1991	○Hong Kong (Hong Kong Telecom's ISDS)
Apr. 1991	○Belgium (RTT's ISDN)
Nov. 1991	○U.S.(Bell South)

4 BARRIERS TO GLOBAL ISDN

Although more and more countries are being connected to NTT's INS-Net over ISDN links, there are still some barriers that stand in the way of further global penetration.

As the number of global ISDN customers has increased, so has the demand for diversified applications. But so far, due to the limited range of global ISDN compatible terminal equipment, applications are largely confined to G4 facsimile transmission and video conferencing. There is also a barrier based on the technical defferences among each country's ISDN that hinder further penetration, such as the difference in the transmission speed of ISDN between Japan and the U.S. (the transmission speed ISDN in Japan is 64kb/s, while that in the U.S. is 56kb/s). This forces customers to obtain terminals with the extra functional capability to adjust between speeds.

To break through such a situation, NTT has made every effort. One of its efforts was holding presentation of applications for global ISDN demonstration at the "NTT collection'90" exhibit.

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5 PRESENTATION OF GLOBAL ISDN AT "NTT COLLECTION '90"

5.1 SUMMARY

Today, INS-Net customers' needs to use ISDN worldwide are increasing day by day because of its cost effetiveness and new value-added applications. In order to cultivate customers' needs for global ISDN, NTT has been making efforts to make them realize the advantages of global ISDN, especially by demonstrating some actual applications of global ISDN between Japan and several other countries at the "NTT collection '90" exhibit. The demonstration attracted a lot of visitors and they showed keen interests in global ISDN. Moved by the demonstration, many visitors, who had no chance to experience global ISDN directly, resolved to introduce INS-Net so they could take advantage of global ISDN.

Here NTT presents its experience of the global ISDN demonstration at "NTT Collection '90", hoping that it will be helpful for the execution of "TRIP '92", the demonstration for promoting the National ISDN 1 (NISDN1) in the U.S.

5.2 "NTT COLLECTION"

The "NTT Collection" exhibit has been held annually since 1987. This is our biggest exhibition, and it rolls out our latest technologies, products, and services.
The exhibit is open to our customers, and the public, and virtually every major company in Japan came by to see what we have to offer and what is in store.

5.3 DATES

October 15, 1990	• Presentation to the press
October 16, 1990	• Presentation to specific large customers
October 17, 1990	• Presentation to specific large customers
October 18, 1990	• Presentation to specific large customers
October 19, 1990	• Presentation to the general public
October 20, 1990	• Presentation to the general public

5.4 PLACES

NTT Collection was held at the NTT TWINS Building in Shinagawa, Tokyo.
The counterpart places overseas in the Global ISDN presentation was demonstration centers of counterpart common carriers and terminal manufacturers.

5.5 THE COOPERATORS OF THE DEMONSTRATION

Five overseas common carriers, KDD, and a number of as terminal manufacturers cooperated to ensure the success of the demonstration.

(1) 4 INTERCONNECTED COUNTRIES

- United States
- United Kingdom
- France
- Singapore

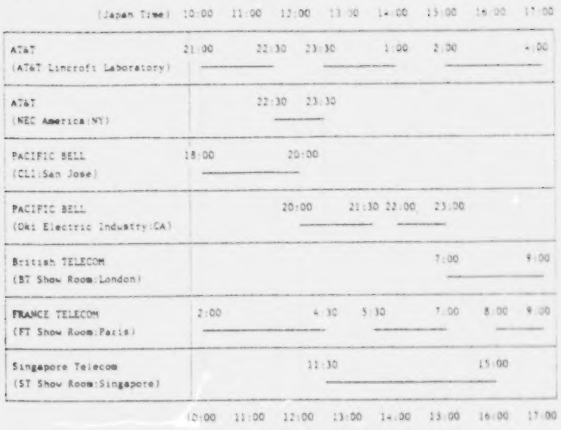
(2) 6 COMMON CARRIERS

- AT&T
- PACIFIC BELL
- British TELECOM
- FRANCE TELECOM
- Singapore Telecom
- KDD

(3) 9 TERMINAL MANUFACTURERS

- CANON SALES
- FUJITSU
- IBM
- KYOCERA
- NEC
- Oki Electric Industry
- RICOH
- SONY
- YAMAHA

5.6 PRESENTATION TIME


(Japan Time) 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00
AT&T (AT&T Lincroft Laboratory) 21:00 22:30 23:30 1:00 2:00 4:00
AT&T (NEC America:NY) 22:30 23:30
PACIFIC BELL (CLI:San Jose) 18:00 20:00
PACIFIC BELL (Oki Electric Industry:CA) 20:00 21:30 22:00 23:00
British TELECOM (BT Show Room:London) 7:00 9:00
FRANCE TELECOM (FT Show Room:Paris) 2:00 4:30 5:30 7:00 8:00 9:00
Singapore Telecom (ST Show Room:Singapore) 11:30 15:00
10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00

5.7 DEMONSTRATED APPLICATIONS (SYSTEM CONFIGURATIONS)

See Attachment

5.8 ISDN CONSULTING CORNER

A global ISDN consulting corner was set up next to the demonstration corner. One representative from each of the carriers' was assigned to the corner to explain the carriers' ISDN service offerings and answer a lot of questions.

6 IMPACT OF THE DEMONSTRATION

"NTT Collection '90" attracted about 40,000 visitors and 150 members of the press through the session. A lot of visitors touched the global ISDN applications directly and realized the usefulness of global ISDN. In general, they showed a keen interest in global ISDN applications. Especially, the demonstration of the floppy disk data transfer system, with capability to transmit 1 Mbyte of data between Japan and the U.S. quickly and easily, was a crowd pleaser. Also, BT sponsored press event effectively by using the video conference between Japan and the U.K. with "CCITT standardized CODEC", and attracted the members of the press participated in the U.K.

About 100 visitors took advantage of the consulting corner for global ISDN. Most of them asked questions, supposed an actual use of global ISDN. Among them were what terminals were available among what countries or carriers, how long it would take before ISDN is available in each country, and to what extent communication costs could be cut.

7 THE ISSUES IN POPULALIZATION OF GLOBAL ISDN

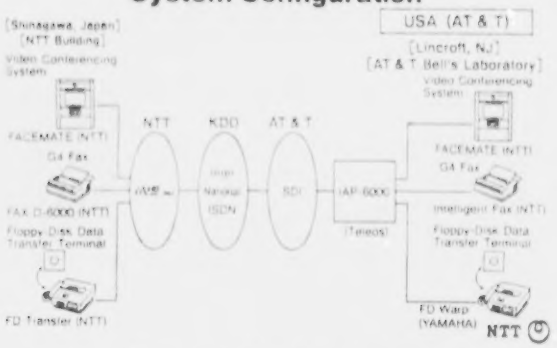
Through holding the demonstration of global ISDN at "NTT collection '90", NTT realized how it was time-consuming to make global ISDN available. In order to make the global ISDN links available, NTT had to hold several connection testing between Japan and the overseas countries. Also, to select available applications NTT had to search on what terminal equipment by what vendors was available among what countries or carriers, by holding connection testings carefully. These things were very difficult, thinking of the time differences between Japan and these countries. The demonstration could not have succeeded without the close collabolation of common carriers, terminal manufactures, and customers.

As mentioned in section 4, significant barriers to global ISDN remain including the limited range of terminals, and problems stemming from technical differences among countries (e.g. the transmission speed difference between the U.S. and other countries). NTT has researched the availability of terminals that can be used for global ISDN links and summarized the findings in a brouchure, called "Global Application" for customers who would take advantage of ISDN but don't know how. Through this effort, NTT realized the range of available terminals are almost limited to between the same models, or more, between the same vendor's models, and that in fact, few end-to-end connection testing of terminals on global ISDN link has held so far.

To overcome these barriers, telecommunication carriers, terminal equipment vendors, and customers around the world must collaborate much more closely. More specifically, this will involve end-to-end connection testing and clarification of global ISDN terminal availability.
NTT expects that the activity to promote the National ISDN 1 (NISDN 1) in the U.S. would be helpful to overcome the barriers, and that the demonstration, called "TRIP '92", one of the most important activity to promote NISDN 1, which will be held by the North American ISDN User's Forum (NIUF) in November 1992, would succeed in promoting NISDN 1 in the U.S. and promoting global ISDN.
Through the collabolation, NTT hopes that the day will come soon when peoples all over the world are connected by ISDN.

Attachment (Demonstrated applications
at the "NTT Collection '90 " exhibit)

System Configuration



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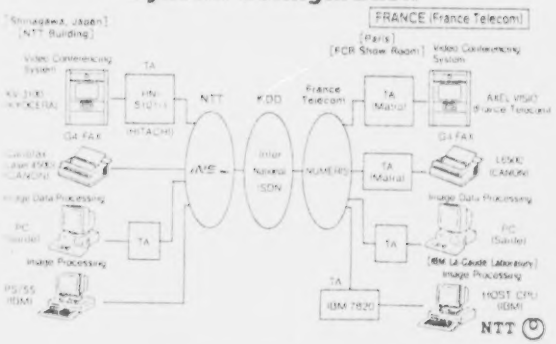

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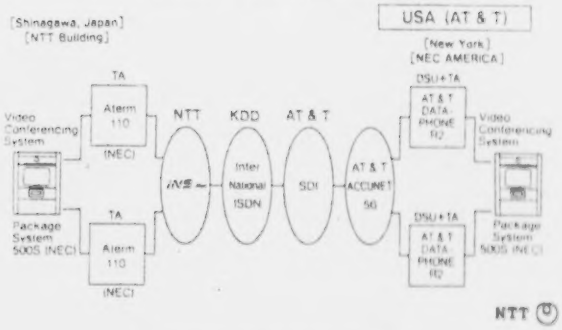

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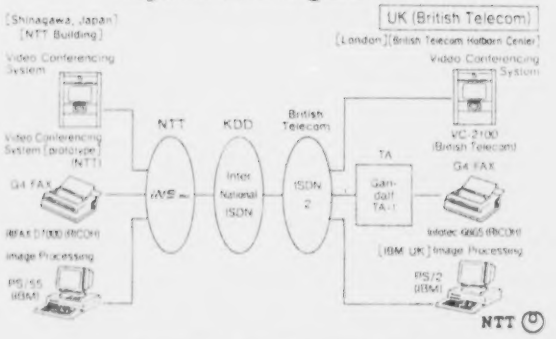

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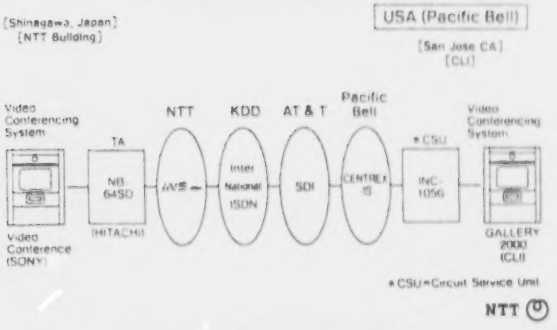

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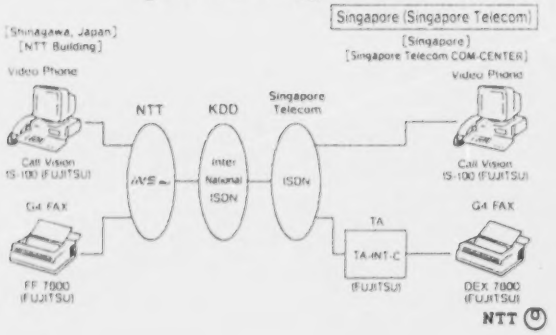

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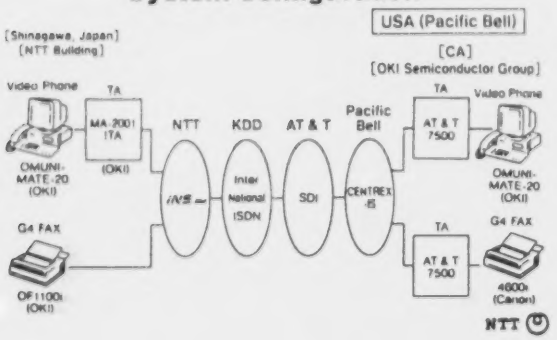

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Storage concepts for moving picture database on B-ISDN

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1. Abstract
We present some concepts necessary for the network file system in B-ISDN, in particular for the handling of moving pictures. From the view points of architecture and hardware, multiple-access can be considered the most important factor in the network file. A prototype network file system as an infrastructure for the advanced storage system in B-ISDN is also presented.

2. Introduction

Recently, a great amount of research has been done on the Broadband Integrated Services Digital Network(B-ISDN) especially the area of network architecture. Outside of this study, however, there has been almost no detailed discussion on the B-ISDN storage system. If data were to be treated on B-ISDN in the same way as it is in existing networks, the storage system, which is called the network file in B-ISDN, would not require any drastic changes. However, the most highly anticipated new developments in B-ISDN is said to be the various services that will based on visual database systems. The basic concept of the network file system that will be used in the near future is shown in Fig. 1. With such a system, users can access any database they desire through B-ISDN[1,2].

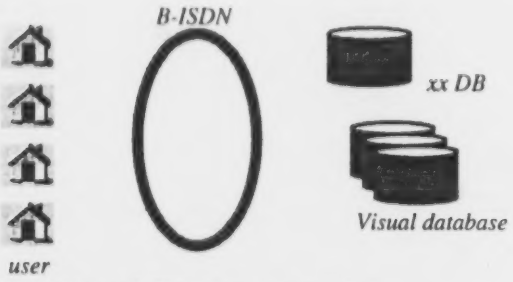

Fig. 1 Network file system concept view

From a technical viewpoint, one of the most significant factors is the sheer amount of visual data, which exceeds the amount of conventional code data by more than one hundred times. This vast amount of data coupled with the fact that it should be reproduced at a constant rate necessitate a very fast transfer rate along the order of several MB/s. This rate refers to not only the transfer rate between disk and controller, but also BUS speed and network transmission speed. To satisfy the rate requirements, SCSI-2, IPI-3 BUS and B-ISDN, and FDDI network have been proposed. Basically, there are two approaches to these technologies. One is to increase the BUS transmission speed itself. The other is to use a parallel transmission method.

The characteristics of visual data also make it necessary to devise a way of managing it, that is very different from the way which conventional code data is managed. Most kinds of visual data will be used in the database system, therefore interactivity is the most important factor to include in the database. However, it is very difficult to achieve interactivity when working with visual data because this kind of data is basically time-oriented.

Furthermore, visual data should be synchronized with other forms of attributed data, such as audio or text data. Recently, some experimental systems which can synchronize moving picture data with audio data that are based on concept of a logical time system have been reported[3]. In these systems, only the software is used to control the synchronization. It is true that this software control is very important, but synchronization can be made easier by using time recognition in the storage system. File allocation of moving pictures presents the same problem. The difficulty for a visual database in terms of file allocation is caused by its vast quantity and its time-dependency. We will discuss these problems in this paper.

3. Multiple-access method

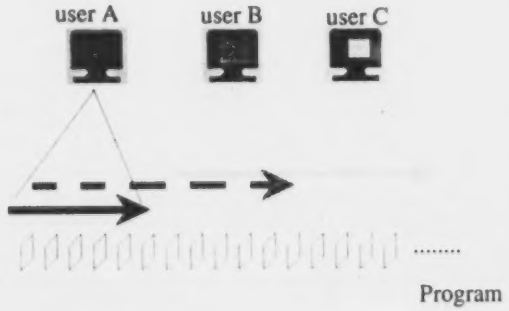

Fig. 2 Multiple-access image

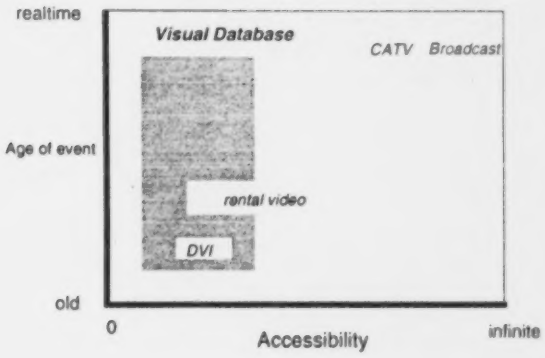

Fig. 3 Accessibility vs. freshness

The most important requirement for the visual database storage system is to provide multiple access to the same moving picture. Figure 2 shows the case when many users are accessing the same program which images time bar of moving picture data. Users access the program randomly in terms of time and place. To provide this kind of service, the system needs very advanced multiple-access technology because of the characteristics of moving picture data.

There are several ways of realizing this multiple-access function now, the most practical of which is the "copy" technique, which is also the cheapest way at present. This method is used in CDs, music tapes, magazines, and newspapers.

People can gain access to the same program content in this way. Even in the field of visual databasing, the copy technique is widely used, in as rental video shops for instance. Figure 3 maps several kinds of media from the point of view of accessibility and age of events. The most important aspect of the database is interactivity. Interactivity is defines as very fast accessing in this paper. Bellcore introduced an on-demand television service based on the copy technique two years ago in what can be considered as the first presentation of multiple-access for visual data[4]. However, with this service, the user often has to wait around several hours because of the slow coping process. We present here a more practical and adequate system for a visual database that does not use the copy technique. Our approach allows several users to access the same moving picture data within a few seconds of each other, making it a truly interactive access system.

There are many possible candidates that can be used to construct this system. From the viewpoint of performance, the use of a silicon file is the most adequate because of its very fast accessing time. However, its very high cost precludes its use. Moreover, the amount of data in a one-hour NTSC television, for instance, is more than two giga-bytes, requiring total filing capacity of roughly several tera-bytes for one system. From this viewpoint also, silicon files are not practical. Other file systems, such as magnetic tapes, optical disks, etc., are not yet fully adequate because of their very poor accessibility. If these systems can attain very fast access rates in the near future, using them may become feasible. Currently, disk arrays provide the very fast transfer rate for necessary achieving interactivity.

4. Basic Concept for the network file

Conventional storage is designed based on "byte count". This is because byte loss can not be allowed in the processing of code data. Only by supervising "byte count" can software be kept independent from storage performance parameters, such as transfer velocity and access time. In terms of the storage function, faster data transfer is only required for a controlled FIFO queuing mechanism, as shown in Fig. 4. This architecture also helps to achieve high storage performance as well.

However, in handling audio or visual data, a conventional byte-oriented storage system loses some of its flexibility in upgrading performance. This is because audio or video data should be reproduced at its own constant velocity. If, for example, a compact disk player controlled the CD rotation at various speeds, the reproduced sound could not be recognized as music. The easier way to use a conventional storage system for these kinds of data is to maintain a constant length and speed. In this case, however, the data

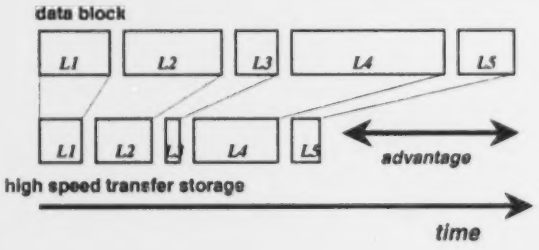

Fig. 4 The conventional storage architecture based on "byte count"

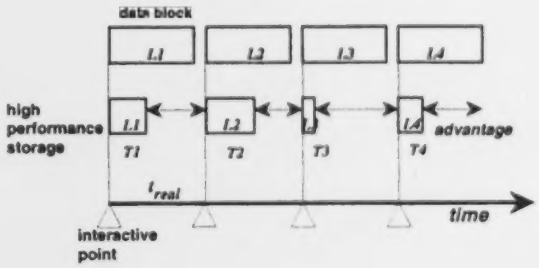

Fig. 5 The data transfer concept for the network file storage based on "time compression"

format has to be reconsidered every time the storage is upgraded. Moreover, the effective data transfer rate at the user terminal will not be constant.

In data transfer, it is not necessary for the time of data transfer T to equal the time to reproduce t_{real}, but it is necessary for data transfer to be complete before the beginning of the next data block, as shown in Fig. 5. The required buffer size depends on the the terminal processing power. This means that if the storage system recognizes the time t_{real}, it will perform more flexibly. Here a time compression rate TC defined as

$$TC = T / t_{real},$$

is introduced as a way to improve the storage performance. *Here*, t_{real} would be the minimum interactive period in the visual database, and T depends the storage performance. Smaller TC can improve storage subsystem capabilities. The new storage concept described in the following section serves as the basis for control TC.

4.1 Multiple-access capability

The most important requirement for a visual database network file is to allow many users to access at anytime, the same moving picture data. This requirement can be satisfied by using a time-based storage system which can maintain TC as

$$TC < 1 / MAC,$$

where MAC stands for Multiple-access capability and means the number of users who can access the same moving picture data at the same time. Figure 6 shows the case when many users are accessing the same program, which is shown as a time bar of moving picture data.

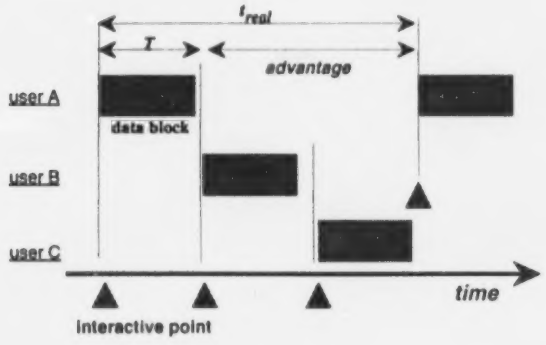

Fig. 6 Multiple-access to the same moving picture data

4.2 File acquisition loss

When the user the skips from one scene to another during an interactive order, the required moving picture data may not be located at the continuous storage area. In the worst case, it would be stored in another storage system in the network. Maintaining a continuous reproduction of the moving picture data stream requires

$$TC < 1 - T_{connect} / t_{real},$$

where $T_{connect}$ is the overhead time needed for a user terminal to search and connect to another storage area. The storage system itself cannot control this time, so the controller needs to send the information from the terminal to the storage system. Figure 7 shows the time bar the different storage systems are linked. If multiple-access is allowed in a linked storage system, TC is described as

$$TC < 1 / MAC - T_{connect} / t_{real}.$$

4.3 Hardware approach to multiple-access

TC can be concretely described by using the hardware parameters

$$TC = \frac{t_{real}}{T} = \frac{t_{real}}{T_{acc} + \frac{L(t_{real})}{V}},$$

where T_{acc} is the maximum access time including one rotational time and the maximum seek time, V is the transfer rate from or to the storage system and $L(t_{real})$ is the transfer data length in one interactive period which is related to t_{real}. Among these parameters,only V, T_{acc} and $L(t_{real})$ can be controlled.

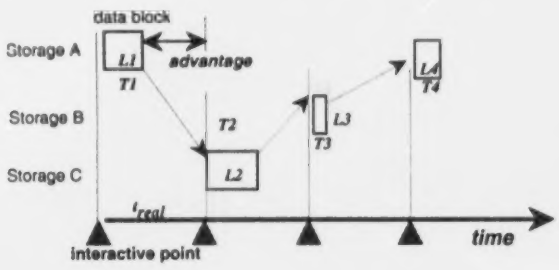

Fig. 7 The linkage to the distributed moving picture data

V is clearly the most sensitive parameter, because $L(t_{real})$ is very huge when moving pictures are handled. This means that the network file must enable high-speed transfer with a low overhead physical interface. Parallel transfer technologies, such as disk arrays, are very suitable for this purpose. $L(t_{real})$ is generally not a variable parameter, at least in code data processing. The compression technologies for the moving picture which are represented by MPEG, JPEG etc.[5,6] point to the possibility of controlling $L(t_{real})$ by the storage system. If storage could control the compression rate or method according to the TC requirement, the effect would be equal to one when V is increased. When $L(int) / V$ becomes small through the high-speed transfer technologies or a high-capability compression method, T_{acc} becomes significant. However, it is difficult to decrease an access time, which depends on the mechanical factors, in the near future.

As mentioned above, the creation of a moving picture database depends upon improving storage performance to the point where interactive points can be recognized. In other words, the highest priority of the storage for a moving picture database is to complete the transfer of the requested data in time for the next interactive point, even if a acceptable level of byte loss occurs. The first step toward improving in the storage architecture for moving pictures is the introduction of switching control mechanism that can monitor the timing of the interactive point for each user. This approach, which is used in our proposed, will be described later in this paper. The next step requires the recognition of the time-based characteristics of the stored data as the parameter to control the effective transfer rate.

4.4 Hierarchical architecture

Conventional storage hierarchy provides random access storage. At the higher level of this form of storage, such as the "on-line" file storage in RAM disks and HDDs, offers high performance at high cost. At the lower end, there is sequential access storage such as the "the off-line storage" in MTs, that offers large capacity at lower cost. Recently a library system with an automatic media handling mechanism has replaced the stand-alone MT. That acts as a "near-line storage" method. This hierarchical storage system is usually controlled so that the active data is registered in the higher level and inactive data is copied from the lower level to the higher level by the staging architecture when the data is accessed.

This architecture is most effective in handling short file[7,8]. If the staging architecture is adopted to moving pictures, it would take a very long time to copy it from an off-line file to an on-line one. Because the fast response time is so vital to achieving the interactivity that will satisfy user demands. Architectures based on staging are not suitable for moving pictures. Such an architecture is also unsuitable from the viewpoint of storage system cost. Figure 8 shows a staging model from which the data block is accessed after being loaded from the MT to HDD and a non-staging model from which the data can be accessed directly such as an ODD with sufficiently high performance to be connected to B-ISDN.

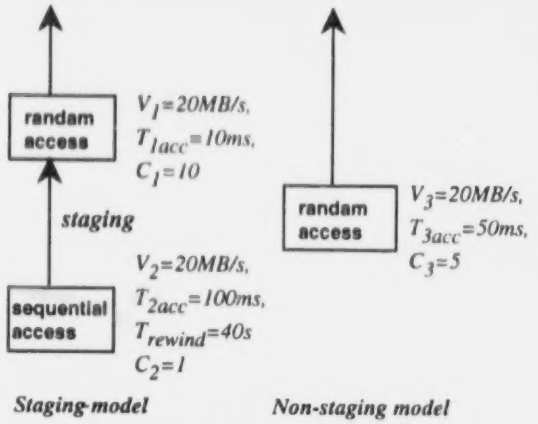

Fig. 8 The model of the staging or non-staging architecture

The cost for the staging model can be evaluated as

$$cost = (C_1 + C_2) \times T_{(staging)} + C_2 \times T_{(rewind)} + C_1 \times T_2 \text{ (online)},$$

while the cost for the non-staging model is

$$cost = C_3 \times T_3 \text{ (online)},$$

where,

$$T_i \text{ (online)} = N \times (T_i \text{ (acc)} + L / V_i) \quad (i = 2,3), \quad N: \text{Number of access}.$$

Details of the evaluation method can be found in [7,8].

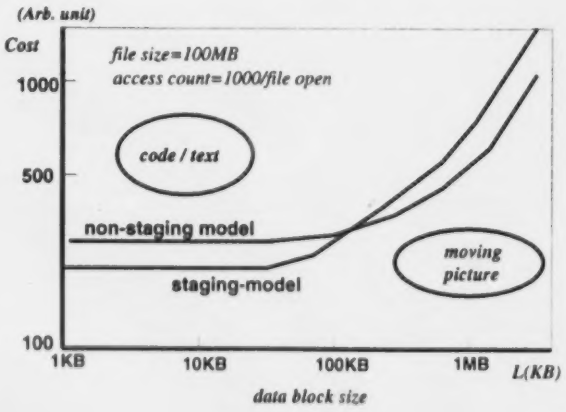

Fig. 9 The hardware cost saving effect by the staging architecture

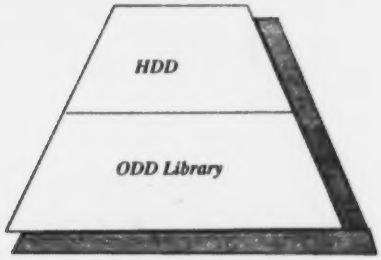

Fig. 10 The storage hierarchy for the moving picture data

Here, C_i means hardware cost per unit of capacity while maintaining the required performance. Figure 9 shows the relationship between the block size and the savings in storage cost achieved by staging. This figure shows that staging cannot save hardware cost when moving pictures with a large block size L are handled, indicating sequential access storage will not be effective for moving pictures. On the other hand, a library which can automatically handle the inter-changeable random access volume, such as an optical disk cartridge, is required at the lowest level of the storage hierarchy because the amount of inactive data will increase more and more so that important moving picture data can be stored for a long time. The storage hierarchy for the moving picture data is as shown in Fig. 10.

5. *MAMI* technique

We propose here a Multiple-Access for Moving picture Information (*MAMI*) system. That can perform the multiple-access function for moving pictures through a network or BUS[9].

5.1 Schematic view

As previously described, constant reproduction and multiple-access methods for visual database are *MAMI*'s most significant functions. The former function was gained by improving the effective transfer rate to *1/MAC* times. This control is achieved by supervising the real time needed to transfer through the use of a real time operation system. NTSC television needs 30 frames / 60 fields per one second. Of course, these frames should be reproduced at a constant interval. In other words, a user can not accept data as code data sent as a packet. The client module controls the speed of input and output. The problem in the *MAMI* system is how to achieve a high-speed transfer rate.

The most important point to consider is disk array technology. Figure 11 shows the mapping where a typical hard disk and optical disk are plotted. Achieving multiple-accessibility requires an array technique such as that described in this figure.

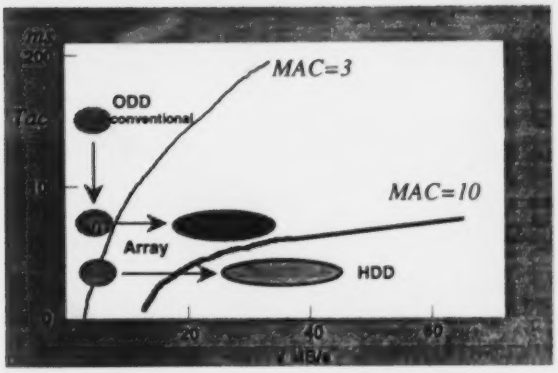

Fig. 11 Access time vs. transfer rate

$$MAC = \frac{T_i}{T_{acc} + KL/V}$$

T_i: *Flexibility* (interaction capability)
L: *Visibility*
T_{acc}, K, V: Hardware performances

Here, it would appear that L represents visibility, and T_i represents interactivity. At first, T_i was assumed as one second. Under this restriction, T_{acc} and V cannot be realized with a conventional disk, as shown in Fig. 11. This equation also shows that if a user can wait a long time, T_{acc} would not be an important factor. Only the copy approach would be effective in this case.

5.2 Hardware improvement

In this section, some important technologies for a storage system which files moving picture data are described. The first one is a fast transfer technique. In the recent past, some disk array systems in a commercial base have been announced. Most of them can be recognized as off shoots of RAID-3, which was proposed three years ago[10]. Two of the five categories proposed by Katz et al., are the concepts of reliability and fast transfer rate. The concept of reliability does not seen to be important for visual data; reportedly an error rate of less than 10^{-5} would be sufficient. This is equivalent to a rate of one error per pixel, a rate which most people would not consider important.

832

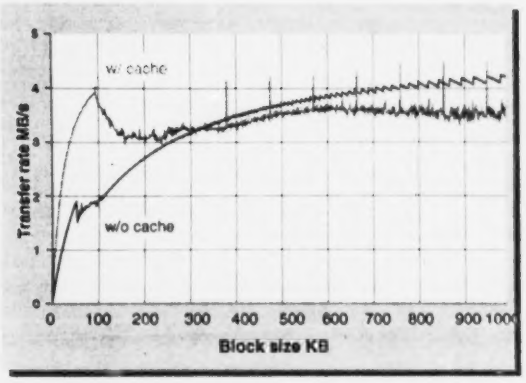

Fig. 12 Transfer rate vs. block size

A disk array system provides a very fast transfer rate as a function of various kinds of conditions. Block size is one of the most effective parameters affecting transfer rate. This effect is shown in Fig. 12. A UNIX file system generally supports 8 KB block transfer. As this figure shows, such a small block size can not support a fast transfer rate. In this case, the cache method would be very effective. This figure also shows that a very large block size should be applied for visual data. The *MAMI* system, which uses VxWorks OS as real-time operation, adopts a block size of around one MB. This OS does not have its own internal file system. Therefore, a very effective file system can be flexibly constructed.

One more important function is BUS performance, which includes internal and external interfaces. One conventional system has been tuned for short code data which does not need a fast transfer rate. Recently, some fast interfaces for disk systems have been announced. The SCSI-2 was adopted in the *MAMI* system from the point of cost. Some special interfaces exist that can achieve very high performance, but they are not economical. Visual data needs to be stored in a cheaper way because of its vast quantity.

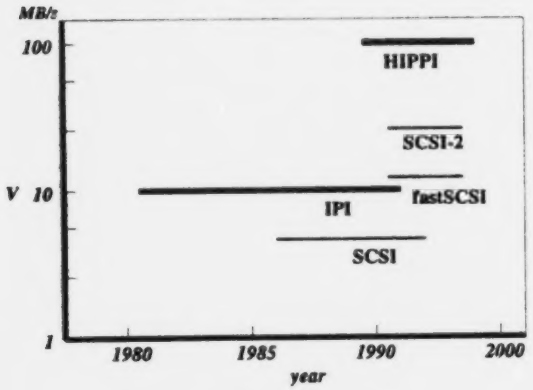

Fig. 13 BUS performance

6. Conclusions

The network file system is vital part of the infrastructure in a B-ISDN system especially for the handling of moving pictures. True multiple-access to moving pictures, represents the most significant aspect of network file systems from the viewpoint of architecture and hardware. We proposed a viable alternative to current multiple-access methods for moving picture data in B-ISDN that we call *MAMI*. The *MAMI* system is based on the disk array subsystem technology, scheduling techniques, and constant transmission techniques. Various kinds of B-ISDN services, especially those utilizing moving picture data, will use this technology in the near future

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To Market, To Market: ISDN in Hawaii

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1. ABSTRACT

ISDN is scheduled for introduction to Hawaii in early 1992. Without the benefit of having had ISDN field trials in Hawaii, local businesses and the market they represent may leave the fate of ISDN's success in the hands of its providers.

2. INTRODUCTION

"ISDN hits Hawaii Market."

So will read the headline in early 1992 if all goes according to the plans of GTE Hawaiian Telephone Company, Hawaii's local exchange company (LEC). The road to getting ISDN in Hawaii has been a cautiously bumpy one -- and it's far from being without more proverbial potholes along the way to full implementation.

3. ISDN PROGRESS: PERCEPTIONS AND MARKETS

One can follow the stop-and-go progress of Integrated Services Digital Network with a quick look at how it has been portrayed in American telecommunication trade journals.

For years, the perception among these trade journal authors has been one of general optimism toward ISDN. Initially there were the explanatory articles describing what it is. Then came the articles on the standards-making process, the ISDN field trials, and finally the success stories of those corporations which are making unlimited progress in their business aspirations via this digital network that the telecommunications industry had been constructing for nearly two decades.

But nothing seemed to be happening very fast. After all, after ten years of articles about the same digital "superhighway" -- and it still hadn't materialized commercially -- there had to be some major roadstops somewhere. At times readers could catch a glimpse of what was holding ISDN back: a prolonged standards-making process, delays in the digitization of central offices, the lack of customer premises equipment, regulatory hurdles, market interest.

Market interest?

How could a global network conceived to take care of every possible business -- and residential -- communication problem and need have trouble getting its foot in the market's door? The problem is apparent: Not many corporations in the United States today have embraced ISDN, even where it is available (unlike personal computers, facsimile or LANs), nor has corporate America been pounding on the door of the LECs to "let them in" to the ISDN network. There are, in fact, indications that corporate telecommunication managers know as little about ISDN as they did when the concept of ISDN first appeared. In any event, they are skeptical of its promise (1).

Hawaii certainly is no exception to this general trend of skepticism, making the step toward ISDN a slow and cautious one. (ISDN is expected to make its appearance in Hawaii during the first quarter of 1992.)

This caution is in sharp contrast to Hawaii's Pacific neighbors -- Singapore, Japan, Hong Kong, Taiwan and others -- who are actively pursuing state-of-the-art ISDN systems (with corporate and residential users in mind) to the extent of implementing broadband ISDN (B-ISDN) in the near future. Many U.S. mainland counterparts, as well, have seen recent progress -- albeit less encompassing -- in commercial ISDN applications. Which markets are they tapping? Finance, medical, retail, high technology... industries transporting high volumes of data that need ever-increasing speed, the lowest possible error rates and economical rate structures. Hawaii has her own share of organizations falling within these categories.

4. HAWAII'S MARKET FOR ISDN

With a cautious attitude on the part of Hawaii's LEC, it is no wonder that Hawaii's local market is, at best, guarded toward the idea of adopting ISDN.

Similar to recent mainland U.S. studies, preliminary results of a survey of Hawaii's largest businesses -- within industries targeted by GTE Hawaiian Tel as most likely to adopt and implement ISDN (2) -- show that a large proportion of telecommunication/voice/data managers in Hawaii know little about ISDN. In fact, as their knowledge of ISDN grows, so does their skepticism of ISDN as a user-friendly/economically viable network alternative. Most feel the risk is high to adopt ISDN within 1-2 years. Very few had been approached by GTE Hawaiian Tel regarding ISDN service.

While still preliminary, the implications of the survey results are startling. GTE Hawaiian Tel officials state that market readiness is one of two main reasons why ISDN has not yet been implemented in Hawaii. (The other reason is lack of universally accepted standards which, with the implementation of National ISDN-ONE in mid-1992, is already on the road to resolution.) What is being done to make the market in Hawaii more ready -- or at least more informed

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-- so that telecom managers can make informed choices about adopting ISDN or not once it's here?

One ISDN information dissemination outlet has been the Hawaii Telecommunications Association (HTCA), a local organization with about 200 members. While a fairly comprehensive report is given each year on the state of telecommunications and coming changes (including ISDN) in Hawaii, less than 50 percent of the people surveyed (in charge of planning telecommunication systems among Hawaii's largest businesses) belong to the organization. Apparently, without direct contact from a telco representative, they have only trade journals and industry hear-say to keep them up to date on any ISDN developments.

Until ISDN promotion reaches their own conference rooms, it seems unlikely that they will be among the first to adopt ISDN once it is offered.

5. THE STATE'S QUEST

For several years, Hawaii has tried to promote an image of linking East with West -- via transportation and telecommunication systems. While Hawaii was an early participant in submarine cable communication (1957), the state has since lost ground in its quest as a technological innovator. Much like the nonstop flight between Japan California, telecommunications undersea cables and satellites are doing their fair share of bypassing Hawaii.

ISDN has the potential of opening up the state's doors to the kinds of business that would diversify its economy from its current tourist-dependent base to one with a technology base (3). (The reasons to pursue such diversification are many, including protection against economic downswings, as Hawaii experiences just a year ago during the Gulf crisis when tourist numbers dwindled. The high-paying, environmentally safe information technology-related industry would also lend itself nicely to Hawaii's high cost of living and its image of environmental purity.)

Since 1988, the state legislature has attempted to encourage such diversification through telecommunications and information technology, with the establishment of various agencies to promote and develop applications and business niches in Hawaii that entrepreneurs and businesses based elsewhere would find lucrative. These agencies include HAWAII INC and the High Tech Development Corporation. As yet, not much has gone beyond these activities to develop Hawaii's vast potential in that arena.

On the other hand, without the state-of-the-art infrastructure in place (without basic ISDN, after all, there can be no B-ISDN), harm may actually have been done in luring potential businesses to Hawaii. Case in point is the recent failure of the proposed stock exchange in Hawaii, which couldn't get off the ground because of the lack of Japanese brokers' interest (4). (You can't have running water if you don't have the pipes to carry the water.)

6. DIGITAL ISLANDS

Within the context of ISDN, it is irresistible to link the now popular metaphor of "digital/ISDN islands" with the Hawaiian islands. The geographic reality of Hawaii as a group of islands with the potential of also becoming a "digital/ISDN island" makes it an intriguing task to put these two concepts together.

There is, however, an interesting paradox to this linkage: While ISDN "islands" on the U.S. mainland or elsewhere suggest some sense of isolation, of incompleteness in their communication/technological systems (until they're linked to several other islands, or until the whole system is ISDN), Hawaii would seem to have an advantage as an ISDN island, with unlimited interconnection capabilities with the outside world -- to the north, south, east and west. (After all, with or without ISDN, Hawaii remains, in all cases, an "island.") A telecommunication system that is the most technologically advanced possible -- if economically feasible -- would surely increase Hawaii's "communication and cultural crossroad" value. It would also enhance intra-state development and communication, from island to island, outside of the metropolitan Honolulu area. Bypass would no longer be an issue.

Not all telecommunication watchers and users, however, are excited about the introduction of ISDN, saying the technology it provides is already "old," or that the investment necessary to complete an ISDN will come at the expense of other telecommunication development. Could it be that Hawaii is more "on track" by being "off track?" Some telecom managers are looking more forward to the state's proposed Switched Digital Network which will offer ISDN-like data transport in early 1992 than they are to actual ISDN.

7. ISDN PROSPECTS

Predictability is a dubious quality. For all the years spent planning, standardizing and implementing ISDN, there is still no industry-wide formula for its success.

ISDN is coming to Hawaii. But whether it is a success among local businesses depends on its rate structure, applications and marketing. For what is most certainly predictable is that without proper and thorough educating and marketing on the part of the telecom providers, ISDN will have to wait still longer to realize its full potential in the Hawaii market.

8. END NOTES

(1) See Budwey, James N. "ISDN Progress in the USA." Telecommunications (North American edition), 24(1990)3:43-44.

(2) Among these industries are banking, hotels/tourism, medical and high technology, as well as state government agencies.

(3) See Takeuchi, Floyd K. "Communication

Technology Seen as Vital to Isles' Future."
Honolulu Star-Bulletin, 2/19/90, p. A-5.

Also see Hooper, Susan. "Down to the Wire."
Hawaii Business, 34(1989)12:15-28.

(4) Pacific Business News, 9/23/91, p. 2.

AUSTRALIA'S NEW TELECOMMUNICATIONS REGIME
THE OPPORTUNITIES EXAMINED

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1. ABSTRACT

During the course of 1991, the Australian Government has introduced substantial reforms to Australia's telecommunications industry. These reforms include the establishment of a private sector competitor to the Government owned Telecom and OTC, the merger of Telecom and OTC, the liberalisation of enhanced services and the introduction of the resale of network capacity. These changes have been occurring rapidly as the new telecommunications regime continues to evolve. This paper will provide a brief history of Australia's telecommunications regulation, an overview of the regulatory structure of the current telecommunications regime and a summary of the most recent developments in Australia's telecommunications industry.

2. RECENT HISTORY OF TELECOMMUNICATIONS REGULATION

2.1 PRIOR TO 1988

Prior to the commencement of the Telecommunications Act 1989 the Government owned Australian Telecommunications Corporation (known as "Telecom") had exercised considerable control over both the provision of domestic telecommunications services in Australia and the regulation of the telecommunications market. The Telecommunications Act 1975 specifically prohibited persons other than Telecom from erecting, maintaining or operating telecommunications installations or attaching lines, equipment or apparatus to a telecommunications system. As these terms were given broad definitions in the legislation, private enterprise was, for the most part, excluded from participation in the telecommunications industry.

2.2 THE MAY 1988 REFORMS

In May 1988 the Minister for Transport and Communications announced significant reforms which resulted in a package of legislation being passed with effect from July 1, 1989. The reforms set out in the Minister's statement and subsequently introduced included:

(a) an authority for the carriers (Telecom, OTC and Aussat) to be the sole providers of basic network facilities and services, subject to the imposition of greater commercial and external regulatory discipline;

(b) full scope for competition in the provision and operation of value added (enhanced) services;

(c) increased scope for competition in the provision and maintenance of network terminal equipment for connection within customers' premises, in particular PABX and small business systems; and

(d) the establishment of regulatory arrangements directed towards insuring maintenance of minimum necessary standards, fair and efficient competition beyond the monopoly boundaries and approved efficiency and accountability for the monopoly carriers.

A complimentary statement issued by the Minister gave rise to reform of the day to day management of Telecom, OTC and Aussat reducing the Government's control over their day to day management.

2.3 THE NOVEMBER 1990 STATEMENT - FUNDAMENTAL REFORMS

Telecommunications policy objectives came under renewed focus with a release of the Government's statement in November 1990 on micro-economic reform in the telecommunications industry. The package of reforms foreshadowed by the November statement included:

(a) the merger of Telecom and OTC to form a corporation to be governed by the Corporations Law and to be known as the "Australian and Overseas Telecommunications Corporation Limited" ("AOTC");

(b) the commitment to the establishment of a private sector competitor to AOTC in the provision of network facilities;

(c) each of AOTC and the second general carrier to be licensed to provide the full range of telecommunications services and facilities domestically and internationally;

(d) greater competition in the provision of telecommunication services (subject to limited exceptions) including unrestricted third party resale of capacity acquired from the carriers;

(e) a substantial increase in the powers of AUSTEL, the independent regulator; and

(f) the termination of Telecom's right to exclusively supply the "first" telephone from June 30, 1991.

The November 1990 statement involved a total of 83 Government initiatives.

2.4 JULY 1, 1991 - THE NEW LEGISLATIVE FRAMEWORK

In June 1991 a package of legislation received Royal Assent and subject to certain transitional provisions effected the repeal of the then existing telecommunications legislation. The new telecommunications legislative package implements the proposals set out in the November statement, subject to certain modifications adopted by the Government following representations made by the public. The legislation lays the ground work for the introduction of a private sector competitor to compete with the merged Telecom/OTC (AOTC) through a statutory scheme for the licensing of "general carriers" who are to be the primary suppliers of Australia's telecommunications networks and services.

The Government has stated that the duopoly created by the introduction of a competitor to AOTC will terminate on June 30, 1997. Although the legislation does not contain an express term specifying the duopoly period the duopoly has been established, and will be terminated, through the Minister's exercise of his powers to issue licences to "general carriers".

2.5 RECENT DEVELOPMENTS

Since July 1, 1991 the new telecommunications regime has continued to evolve. Some of the major developments include:

(a) the announcement that Optus Communications Pty Limited ("Optus") has been selected to be Australia's second telecommunications carrier;

(b) the annoucement that the moratorium on pay television will be lifted;

(c) the grant of a general licence in respect of cordless telephones;

(d) the grant of a general licence in respect of the resale of domestic telecommunications capacity;

(e) the decision of the Government to proceed with the issue of the third mobile telephone service; and

(f) the announcement by the New South Wales Government that it will establish its own private network.

Details of these recent developments are discussed below.

3. STRUCTURE OF THE TELECOMMUNICATIONS REGIME IN AUSTRALIA

3.1 LEGISLATIVE STRUCTURE

The legislative structure of the telecommunications regime in Australia is comprised of the following principal Acts:

(a) the Telecommunications Act 1991 (the "Telecom Act") - replaces the Telecommunications Act 1989 and forms the basis of the regulatory regime including the licensing of general carriers and the relationships between the general carriers, consumers and services providers; and

(b) the Australian and Overseas Telecommunications Corporation Act 1991 - establishes the Australian and Overseas Telecommunications Corporation (AOTC) which will be the successor to all the rights, property, staff and liabilities of Telecom and OTC on a day to be fixed by proclamation and determines the power of the Minister to specify price control or price notification and disallowance requirements and to determine principles to govern price control arrangements.

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Other supplementary Acts regulate such matters as transitional provisions, consequential amendments and fees. Other Commonwealth legislation, including the Trade Practices Act 1974 and the Broadcasting Act 1936, will continue to have an impact on the Telecommunications industry.

3.2 ADMINISTRATION

Responsibility for telecommunications regulation in Australia falls primarily on the Government, through the Minister for Transport and Communications. The Department of Transport and Communications exercises the Minister's day to day responsibilities.

The Telecom Act continues the existence of AUSTEL as an independent regulatory body and increases its powers. The functions of AUSTEL now include:

(a) the economic and technical regulation of the Australian telecommunications industry including the promotion of fair and efficient market conduct, giving advice and assistance to the industry, and giving reports and advice to the Minister;

(b) the promotion of competition within the telecommunications industry including facilitating the entry of persons into markets for services and facilities and promoting competition among the general carriers;

(c) ensuring that the provisions of the Telecom Act are carried out with due regard to the public interest;

(d) receiving and investigating complaints; and

(e) the issue of class licences and permits under the Telecom Act.

In addition, Australian telecommunications regulation is influenced by international conventions. For example, under section 48(c) of the Telecom Act, AUSTEL must perform its functions in a manner consistent with Australia's obligations under any convention of which the Minister has notified AUSTEL in writing.

3.3 THE CARRIER MARKET

Part 5 of the Telecom Act provides for a licensing scheme to apply to telecommunication carriers. Section 55 of the Telecom Act states that the object of Part 5 is to help the objects of the Act by:

(a) establishing a system for licensing "general carriers" on the basis that they are to be the primary providers of Australia's line based and satellite based public telecommunications capacity and the primary suppliers of telecommunication services by the use of "line links" and satellite based facilities; and

(b) establishing a system for licensing mobile carriers on the basis that they are to be the primary suppliers of public mobile telecommunications services.

To give effect to the above, two classes of licences will be issued. The first, "general telecommunications licences", are to be issued to "general carriers". General carriers are to have facilities based reservations. The second category, public mobile licences, are to be issued to "mobile carriers" who are to have certain preferential rights with respect to mobile communications.

Initially, there are to be only two general carriers. These two carriers are to operate under a duopoly structure until June, 1997, after which additional licences may be issued. One of the two general carriers will be AOTC, the merged Telecom/OTC. On November 19, 1991 the Government announced that the other general carrier will be Optus. Optus is an Australian company which is 51% Australian owned. The Australian shareholders are Hayne Nickless, AMP and National Mutual. The overseas shareholders, who together own 49%, are BellSouth and Cable and Wireless.

The public mobile licences are to be issued to each of the two general carriers and a third licence is expected to be issued during 1992 to come into operation in 1993. A submission made to the Government that the third mobile licence be constituted by several regional licences has been rejected.

The general carriers are to have reserved to them the right to install and to maintain "line links" between "distinct places" within Australia. This reservation takes the form of a prohibition on a person other than a general carrier (or a person acting on behalf of or together with a general carrier) installing or maintaining "reserved line links" and a provision which entitles a general carrier to install or maintain such line links. "Line links" include physical lines, cable, and optical fibre. "Reserved line links" comprise line links between

distinct places within Australia or between a place within Australia and a place outside Australia.

The legislation does not confer on the general carriers the exclusive right to operate facilities as the resale of network capacity is now permitted and such resellers will be entitled to operate networks. Also, as the carrier reservations are framed in terms of "line links" there is no restriction on the installation, maintenance or operation of switching facilities.

Certain exceptions will apply to the general carriers' reservations including the following:

(a) line links used by certain transport authorities for their business requirements;

(b) line links used by broadcasters for certain purposes;

(c) line links authorised under previous legislation;

(d) certain line links installed by defence organisations necessary or desirable for defence purposes;

(e) private networks; and

(f) authorisations of third parties by AUSTEL to install, maintain, use or dispose of line links or satellite based facilities.

Although the general scheme of the new legislation is that it does not reserve to the general carriers the right to supply services the general carriers will have reserved to them the right to act as the initial suppliers of services by satellite. Whilst third parties (for example Intelsat) may supply satellite services to general carriers, resellers or others utilising such satellite services must acquire those services directly or indirectly from a general carrier. It should be noted that part of the grant of the second licence to Optus includes the sale of Aussat to Optus.

The Telecom Act provides that only the holders of "public mobile licences" will be entitled to act as the initial suppliers of "public mobile telecommunication services". Whilst third parties may act as resellers of such services, a mobile carrier must be the initial supplier of the service, directly or indirectly. Public mobile telecommunication services are distinguished from other non-reserved services mainly by the existence of cell handover capabilities.

Certain services are excluded from the definition of "public mobile telecommunication services", such as trunk mobile services, one-way only store and forward communication services or similar services such as paging services. The legislation distinguishes between "public mobile telecommunication services" and "public access cordless telecommunication services", which are not reserved services.

3.4 PROVISION OF VALUE ADDED OR ENHANCED SERVICES

Under the Telecom Act "eligible services" is the term used to regulate and to define the rights of service providers under the new liberalised regime. Eligible services are defined under Section 18 of the Telecom Act to mean either:

(a) a telecommunications service supplied by means of at least one reserved line link or facilities including at least one reserved line link; or

(b) a telecommunications service supplied by means of satellite facilities.

Eligible services include a broad range of activities including the resale of capacity, both domestic and international, traditional "enhanced" services such as network managing, bureau activities, video conferencing and store and forward services; operators of private networks utilising capacity acquired from the carriers for their own use who may wish to resell spare capacity; and public access cordless telecommunications services.

Eligible service providers have the right to have their services connected to the networks of the carriers provided that the service is supplied under a class licence issued by Austel.

3.5 PRIVATE NETWORKS

Pursuant to the Telecom Act the general carriers have the exclusive right to install line links between "distinct places". However, within a distinct place a private party may install, maintain and operate its own network. A "distinct place" is a property over which there is a single legal title, but excluding parts of that property which are leased, sub-leased or used by other parties. Adjoining properties under the ownership or lease of the same party or parties having a "shared interest" can be aggregated into a common area and a privately owned and operated network connecting the individual properties in that common area can be installed. This

will allow, for example, a company which leases several adjoining sites to establish a single network over all the sites.

The definition of "distinct place" has been drafted carefully to avoid arrangements entered into for the sole purpose of circumventing the general carriers' reservations. There is a requirement that the same person be the principal user of adjoining distinct places before they can be aggregated into a single area for the purposes of installing a private network.

3.6 RESALE OF NETWORK CAPACITY

Under the Telecom Act, the unrestricted resale of network capacity acquired from a general carrier is permitted. Resale of network capacity may occur when telecommunications capacity is purchased from a carrier by a reseller who then sells the capacity to a third party. The capacity may be enhanced in some way to provide value added services or may be resold without change in its character to provide "simple" resale. Resale can be of both voice and non-voice capacity.

On September 19, 1991 AUSTEL issued a Service Provider's Class Licence which allows any person or organisation to acquire telecommunications capacity from a general carrier and resupply innovative services such as voice and non-voice services, private network services to consumer and commercial markets. A special feature of this Class Licence is that individual providers do not have to apply to AUSTEL for individual approval. Provided that the operators abide by the conditions and requirements of the Class Licence there will be a minimum of bureaucratic interference.

On November 26, 1991 a Ministerial Direction and Explanatory Statement on the resale of international capacity was tabled in Federal Parliament. The Government is conscious that there are some risks in unilaterally pursuing a liberal regime in respect of international telecommunications particularly if this could lead to foreign telecommunications operators operating under less liberal regimes being able to take unfair advantage of Australian carriers or service providers. Therefore the Ministerial Direction provides guidance to AUSTEL on the policy goals the Government wishes to be translated into conditions in a class licence in respect of the resale of international telecommunications capacity.

3.7 PUBLIC ACCESS CORDLESS TELEPHONES

AUSTEL has issued a class licence to allow public access cordless telephone services to operate in Australia. Public access cordless telephone services are similar to mobile phones except that calls can only be made within a range of 50 to 200 metres of base stations. Base stations are likely to be located at heavy traffic places such as railway stations, shopping centres and airports. It is expected that the cordless telephone services will be operated as radio-based public telephones with customers owning their own handset. By issuing a class licence public access cordless telephones will be open to full competition.

3.8 CUSTOMER EQUIPMENT

Section 253 of the Telecom Act provides that a person shall not connect to a telecommunications network customer equipment in respect of which a permit is not in force. Permits for customer equipment are granted by AUSTEL. Such permits are subject in some cases to compliance with the Government's industry development arrangements.

Section 17 of the Telecom Act makes it clear that equipment may be taken to be connected to a network whether or not it is in physical contact with the network if it is being used to supply telecommunications services by means of the network. As such the definition applies to equipment connected indirectly, such as computer equipment connected through a modem. However, under Section 267 of the Telecom Act AUSTEL may limit the provisions regulating customer equipment so as not to apply in relation to customer equipment of this type.

Under the Telecom Act it is an offence to sell or supply customer equipment to a person if there is no permit in respect of that equipment, without notifying the person that there is no such permit.

A general carrier is entitled to cease supplying a service to a person if there is connected to the network through which the services are provided customer equipment or customer cabling that is a threat to the safety or proper functioning of the network or the safety of any person.

Until July 1, 1991 Telecom had the exclusive right to supply the first phone - the handset, cord and plug - to all telephone customers. This right has been withdrawn and has significantly enhanced competition in the area of the supply of customer equipment.

4. RECENT SIGNIFICANT DEVELOPMENTS IN AUSTRALIA'S TELECOMMUNICATIONS INDUSTRY

4.1 SELECTION OF AUSTRALIA'S SECOND GENERAL CARRIER

As stated above, on November 19, 1991 the Government announced that Optus had been selected as Australia's second general carrier. Optus has agreed to pay the Government a total of A$800 million.

The timetable for service introduction by Optus is:

(i) 2nd quarter, 1992 - mobile cellular service marketing commences in every capital city. This service will be based on the resale of Telecom Mobilenet;

(ii) 4th quarter, 1992 - introduction of domestic long distance and international services available to Sydney and Melbourne;

(iii) early 1993 - introduction of new digital cellular services for mobile and personal communications;

(iv) 1993 - provision of value added network services for business.

4.2 PAY TELEVISION

The Government recently announced that the moratorium on pay television in Australia would be lifted. From October, 1992 at least four channels can be delivered on the Aussat satellite, with an additional two to be available for further development of pay television systems. The Government proposes that the multi-channel service will be delivered under a national licence that will be majority Australian owned. Existing free-to-air television licensors (including the Government owned Australian Broadcasting Commission) will be restricted to 25% ownership. Optus, as the new owner of Aussat, may take an equity share of up to 25%.

The Government has guaranteed that important programs, including national and international sporting and cultural events, will continue to be available on free-to-air television. This provision was introduced to alleviate concerns of opponents to pay television who feared that the general public would be denied access to national sporting events.

4.3 NEW SOUTH WALES GOVERNMENT'S PRIVATE NETWORK

The New South Wales Government has proposed the establishment of a New South Wales Telecommunications Authority which would have a virtual monopoly over New South Wales Government telecommunications. New South Wales Government bodies will be obliged to use the Authority.

The New South Wales Government proposes to bypass the Telecom Act by creating a single state-wide parcel of land which would have one title vested in the Authority and which would be used for the construction of the private network, separate to either Telecom's network or Optus' network. Pursuant to the proposal the space occupied by the network and a surrounding space of 300 millimetres would be vested in the New South Wales Government.

Under the Commonwealth Constitution the Commonwealth has legislative and executive power in respect of telecommunications. Therefore, if the Federal Government objects to the proposal it can legislate to prevent the creation of the New South Wales Government's private network.

5. CONCLUSION

Australia's new telecommunications regime significantly enhances competition in the Australian telecommunications industry in several fields. One of the major fields is the third mobile licence. As stated above, the decision to grant the third mobile licence will be made during 1992 with the licence effective from 1993. Another major field available is the grant of the pay television licence.

Other opportunities exist for telecommunications businesses in areas such as the provision of private networks, enhanced services and customer equipment. The issue of class licences allows businesses to enter certain fields with a minimum of bureaucratic interference provided that they satisfy the terms of the class licence.

It should be noted that the new telecommunications regime in Australia is evolving very quickly. For example between the date of writing this paper and the date of the Pacific Telecommunications Council Conference it is expected that the terms of the general carrier licence to be granted to Optus will be settled. Any existing or new participants in the Australian telecommunications industry should keep themselves.

BEST COPY AVAILABLE

Korea Telecom's Globalization Scheme in face of Restructuring of World Telecommunications Industry

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ABSTRACT

As the world telecommunications market liberalizes, new rules and orders are forming among nations and companies according to their comparative advantages. Believing that telecommunications is a futuristic business to continuous national growth and that those who fail to adapt to the competitive environment will eventually disappear, overseas business activity in this area to capture the world market has been increasing dramatically. As globalization accelerates, so does the restructuring of the world telecommunications market. The purpose of this paper is to define the proper roles and strategies of Korea Telecom under this rapidly changing market situation.

1. INTRODUCTION

Since the early 1980s, the world telecommunications industry has grown explosively. The industry is now moving toward state-of-the-art information business emerged by combining the traditional telephone operations based on analog technology with newly developed digital computer technology. As a result, new media appear everyday. This process is accelerating as the user's demands are becoming more and more complicated and diversified. It is also becoming obvious that the old, monopolistic and bureaucratic phone companies cannot be effective to cope with this rapid change. In this regard, there have been movements all over the world to introduce competition and deregulation in the telecommunications business. Believing that information industry be the mainstay of the futuristic society and that securing initiative in this industry lead to the prosperity of the nation, advanced countries have actively pursued free trade in this area through market openings.

Following the opening and deregulation of world market, major telecommunications companies in advanced countries compete to one another to take hegemony and to secure overseas presence. According to their comparative advantages, new rules and orders are forming in the world telecommunications market. This process is expected to continue in the 1990s. According to Mr. Ray Smith (1), Chairman of Bell Atlantic Co, any telecommunications company which could not secure its market presence in the world within the next ten years will disappear in the twenty-first century. Hughes et al. (2) also warn that, the destiny of telecommunications companies be determined by the degree of how much they prepare for the globalization.

> "As the telecommunications industry globalizes, the companies that fail to meet these early challenges will find themselves locked into domestic operations. They will face increasing competition at home and be unable to participate in the growth opportunities abroad."

On the other hand, compared to their recent economic success, developing nations maintain relatively old, insufficient telecommunications facilities, becoming a bottle-neck to the further economic growth. Like other infrastructure businesses, the expansion of network facilities require huge investment, which most of developing countries cannot afford due to their already debt-ridden budget. Besides, it is almost impossible to keep up with ever-changing new technology. They have no choice but to rely on foreign investors for their network expansion plan. Recently this has been creating ample international business opportunities in the world market.

Recognizing the international competition among advanced countries and new business opportunities in developing countries, Korea Telecom has been pushing its own two-stage globalization plan : The first stage of the plan (1980s) has been aimed at expanding network facilities, focusing on the quantitative growth of the company. When Korea Telecom was separated from the Ministry of

Communication in 1982, it operated only two million lines. Now it operates 15 million lines for a population of 42 million people and ranks ninth in the world in terms of subscriber lines. In 1986, the company developed a digital switch, TDX, with its own R&D team and became the tenth nation to possess such technology.

The second stage of the globalization plan (1990s) is directed toward the qualitative growth. Despite the substantial success quantitative-wise, more than 95% of its income comes from voice service, meaning that its business is not diversified at all. At this point, Korea Telecom is in a peculiar position between developed and developing nations. Quantitatively, it may be positioned as a developed, but qualitatively as an under-developed. The paper focuses on the second stage of the globalization plan and attempts to establish for the qualitative growth, and to define the proper roles of the company in face of restructuring of world telecommunications industry.

2. ESTABLISHMENT OF GLOBALIZATION SCHEME

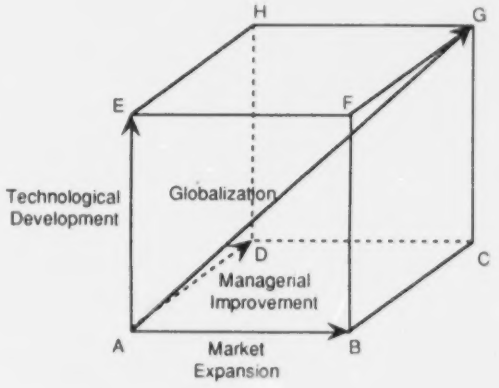
2.1 CONCEPT OF GLOBALIZATION

The term "globalization" is generally defined as a process of diffusing into overseas markets. That is, globalization is as an evolutionary process in which a domestic company begins to concentrate in export markets at first, then transforms itself to a multi-national corporation by shifting its managerial emphasis on overseas investment, and finally evolves into a global corporation whose business functions spread all over the world(3, p.20). This definition contains the concept of geographical expansion such as "a managerial activity happened across boundaries or occurred simultaneously in more than two countries."

However, this conception might not be applicable to Korean companies. Originally, the concept has been established by scholars of advanced countries modelled upon multi-national corporations. For example, when Korean companies pursue globalization, they often want to increase their competitiveness to the level of advanced countries, rather than to advance to overseas markets. In other words, the concept of globalization in Korea is recognized not only in the aspect, "global business activities in more than two countries," but also in relation to global competitiveness. From this viewpoint, globalization is possible not only through advancing to overseas markets, but also by technological development and managerial improvement to some degree. That is, advancing to overseas markets may not be the only mean to achieve globalization.

Likewise, when we interrelate globalization to global competitiveness rather than limiting it to geographical expansion, the concept may be defined in terms of three elements: technological development, managerial improvement, and market expansion (see Figure 1). These three elements strengthen the competitiveness at different levels: technological development at the level of possession of high-tech skills; managerial improvement at the level of rationalization and diversification of management; and market expansion at the level of economies of scale and market information. On the basis of this conception, globalization in this study is defined as "a process of strengthening the global competitiveness through technological development, managerial improvement and market expansion."

(Figure 1) Three Elements of Globalization



2.2 BASIC STRATEGY

In figure 1, there are several globalization paths to reach G from A (e.g., A→B→F→G). Depending on which path is selected, two distinctive types of globalization schemes may be derived. Figure 2 displays these two schemes on a two-dimensional space. Type I represents a market-oriented strategy, which first develops the overseas market with existing technology and managerial skills, later pursuing technological development and managerial improvement on the basis of market demand. Type II represents a technology-oriented strategy, which first puts emphasis on technological development and managerial improvement, later looking for overseas business opportunities.

It may be controversial to determine which type is preferable. Those technologically oriented will insist

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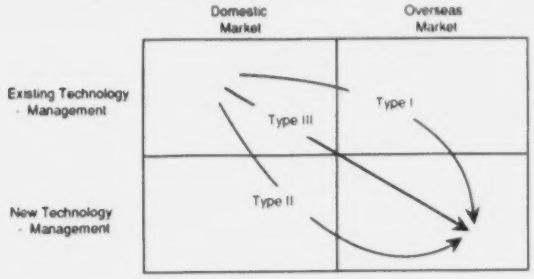
securing global competitiveness internally through technological development and managerial improvement believing that telecommunications in nature is a high-tech industry and hence, technological breakthrough creates new demands. This approach may be also effective to reduce foreign investment risk and technological/managerial disadvantages. On the other hand, those market-oriented will dispute that market expension should precede other factors, believing that global competitiveness can be achieved more effectively through direct competition with foreign companies in overseas markets. As Oettinger (4) points out, the direction of telecommunications industry shall be determined ultimately by users, therefore, demands on new technology and management be assessed through market analysis.

If we take the Korean auto industry as an example, Hyundai has preferred Type I strategy: Hyundai through which it has advanced to overseas markets first and has competed with foreign auto manufacturers existing skills. On the basis of the market experience from the competition, the company later carry out technological development and managerial improvement. However, Daewoo and Kia have concentrated on the internal competitiveness first through technological development and managerial improvement, and only recently begin to advance to American markets through OEM.

In this study, we recommend Type III strategy, an intermediate form between Type I and Type II, which pursues both market and technology at the same time, balancing the efforts. Although technology can broaden the scope of selection for users, the ultimate direction of telecommunications industry will be determined through the choice of users in the market. Therefore, both the technology and the market should be developed in a balanced and organic way. In this respect, Korea, positioned between advanced nations and developing nations, should pursue the market expansion and the technological/managerial development simultaneously, importing high-end technology from advanced countries, while advancing to the markets of developing countries with existing technology and managerial capacity.



(Figure 2) Basic Strategy

3. KOREA TELECOM'S GLOBALIZATION EFFORTS

Korea Telecom has already activated several domestic as well as international programs to improve its quality as a part of second stage globalization plan.

3.1 DOMESTIC ACTIVITIES

(1) The company is expected to go public in 1992.

(2) A new corporate culture is programmed to boost the morale by integrating three elements - information, telecommunications, and human being (5).

(3) The company has initiated a CIP (Corporate Identity Program) and more of customer-oriented managerial approaches.

(4) Several new ventures such as satellite, CATV, software development, information service, etc. are explored to diversify its business and to learn the technology.

(5) Since 1991, the company has changed its name from Korea Telecommunications Authority into Korea Telecom (KT) to build a privatized, high-tech company image.

3.2 INTERNATIONAL ACTIVITIES

(1) ***Expanding Overseas Liaison Offices***: Korea Telecom operates five liaison offices in Washington D.C., New York, Geneva, Bangkok and Tokyo. At present, these offices are mostly used as contact points for foreign carriers, but in the future, their roles and functions will be enhanced to be used as bridgeheads in the overseas business.

(2) ***Supporting telecommunications technology to other developing countries***: Korea Telecom has provided education and training programs on electronic exchanges to ten developing countries including Thailand and the Philippines since 1984.

(3) ***Construction of international submarine cable system:*** As a part of globalization plan, Korea Telecom has actively participated in international construction projects of telecommunications facilities to secure permanent lease of the proposed international transmission routes. The TPC-3 project connecting Japan, Guam and Hawaii (completed in 1983, 15 countries), the HAW-4 project connecting Hawaii and the US, the GPT project connecting Guam, the Philippines and

Taiwan (completed in 1988, 13 countries), the H-J-K project connecting Hong Kong, Japan and Korea (completed in 1988, 14 countries) and the TSL (Trans-Siberian Lines) project are good examples of such efforts.

(4) ***Cooperation with other telecommunications carriers:*** Another important strategy of Korea Telecom is to progressively expand the cooperative relationships with other phone carriers through signing of memoranda of understanding (MOUs). Since signing of MOU with KDD of Japan in 1965, Korea Telecom has exchanged MOUs with 18 carriers from ten countries including the US, France, Spain, Hong Kong. To support "northern policy" of the Korean government, Korea Telecom has signed MOUs with East European countries including Hungary. It also tries to maintain close relationships with EC countries through enhanced cooperative activities and joint development of technology, etc..

(5) ***Overseas business:*** Korea Telecom's overseas business activities is at a preparation stage to test the possibility and to capture the international business experience. At this point, Korea Telecom is taking a very conservative approach to reduce the high investment risk. Therefore, most of the activities are small-scaled, sporadic and in many cases, not pre-planned.

Korea Telecom's overseas business for market expansion includes a couple of management and technology consulting projects - the Twinning program in Indonesia to assist the phone service upgrade and the network expansion in the country, and the Barcelona project to help the construction of telecommunications facilities for the 1992 Olympic. Korea Telecom is also actively pursuing the EABC (Euro-Asia Business Center) project in Netherlands and the network expansion project in Indonesia. For the import of advanced technology, the company has been evaluating several projects including the investment in the USL (Unix System Laboratories) share holdings.

4. KOREA TELECOM'S ROLES IN THE WORLD MARKET

4.1 RESTRUCTURING OF WORLD TELECOMMUNICATIONS INDUSTRY

Recently, the world telecommunications community has been forming, centered around three blocs - "the U.S.," "Japan" and "Europe including the U.K."

Telecommunications carriers from these nations are the most actively engaging in the globalization and advancing to the overseas markets. In the U.S., the Bell Atlantic Co. plans to make 10% of its total revenue from overseas business by 1995. It has acquired New Zealand Telecom and has participated in mobile phone projects in Czechoslovakia and Italy.

AT&T plans to increase its overseas revenue from 15% to 25% by 1995. For this purpose, AT&T has cooperated with European carriers and manufacturers including Philips, Olivetti and Italtel to advance to European markets and, lately, acquires NCR, an internationally-known computer company, to secure world markets (6).

NTT's overseas business activity is sluggish compared to their U.S. and European counterparts due to their restrictive domestic law. Yet their technology is state-of-the-art, directed toward VI&P (Visual, Intelligent, and Personal) communications (7).

In Europe, British Telecom has participated actively in the international value-added network (IVAN) operations by acquiring Tymnet and Dialcom of the US, to increase the revenue from overseas business from 10 ~ 15% to 20 ~ 25%. France Telecom is also advancing to the IVAN markets of Europe and North America and intensifying the marketing of Minitel services internationally. France Telecom also plans to increase the revenue from overseas business to 10% before the turn of this century. Telefonica of Spain and STET of Italy have also advanced to markets of South America, including Chile and Argentina, and East European countries. Likewise, present world telecommunications market is becoming a battlefield of world telecommunications carriers, fighting for the initiatives in the overseas market.

On the other hand, Indonesia, Columbia, East Bloc, and other developing countries are looking for foreign investors to expand their network facilities. This network infrastructure expansion requires heavy investment that foreign debt-ridden developing countries cannot afford. Insufficient network facilities are becoming a bottleneck to the successful implementation of continuous economic growth.

To attract foreign investors, A BOT (Build, Operate, Transfer) type project is often offered in which foreign investors finance, construct, operate, and transfer to the host country after realizing a sufficient return. Developing Countries prefer this method, since they can own network facilities after a certain period of time without hurting their foreign-debt situation and also they have a chance to learn efficient management skill. Sometimes, in order to make the project more attractive, foreign investors are allowed to maintain a limited ownership of the installed network facilities, called BOO or BOM project. Thailand has been

successful to host BT and CP, a Thai company, for its expansion plan with a BOT-type approach. Indonesia is currently offering a similar project.

Yet the BOT project may not look that much attractive from the investors' viewpoint due to a long return period compared to its heavy investment. For the hosting countries, the maintenance of the facilities is also very costly and besides, ever-changing new technology is hard to keep up with. In this regard, several countries offer the sales of their main phone carriers (e.g., New Zealand, Mexico, Venezuela, Puerto Rico, etc.) with some requirements specifying a certain level of network expansion, service improvement, and investment amount by foreign investors. These ample business opportunities in developing nations as well as fierce competition among advanced countries are creating new rules and orders in the world telecommunications industry.

4.2 KOREA TELECOM'S ROLES

Korea Telecom operates 15 million lines for a population of 42 million people and ranks ninth in the world in terms of subscriber lines. Yet more than 95% of its income comes from voice service, meaning that its business is not diversified at all. Quantitatively, Korea Telecom may be positioned as a developed, but qualitatively as an under-developed company.

As discussed earlier, Korea Telecom has focused on the quantitative growth in the 1980s during the first stage of the globalization plan. In the 1990s, during the second stage of the plan, the company's emphasis will be moved toward the qualitative growth in the directions of technological development, managerial diversification, and market expansion into the world. This ambitious plan may not be possible without the technological and managerial assistance from the advanced nations. In this connection, Korea Telecom and the telecommunications market in Korea will provide one of the most attractive business opportunities for the advanced countries in the areas of enhanced service, softwares, technological/ managerial consulting, and etc.

On the other hand, Korea Telecom can satisfy the needs of network infrastructure expansion in developing nations. In addition to its very efficient skills enough to install 2.8 million lines in 1990 alone, the company has comparative advantages compared to advanced companies in the construction of network facilities.

(1) ***Proper level of technology :*** What the developing countries require is not a hard-to-learn, state-of-the-art technology of advanced countries. They would rather prefer labor-intensive technology which is pertinent to their technological level and has considerable effects on employment of local population.

(2) ***Flexibility of market scale:*** Markets of the developing countries are usually small and have large price elasticity of demands. Accordingly, Korea Telecom has some advantages because it can provide services at elastically low prices on a flexible scale.

(3) ***Compensation to expatriates:*** Telecommunications carriers of advanced countries have to pay fairly high compensation and incentives to their staff to send them to developing countries. They also have difficulties in finding well-qualified volunteers.

(4) ***Supply of telecommunications equipments:*** Korea Telecom has some advantages because it can supply high-quality telecommunications equipments at comparably low prices through Korean manufacturers.

(5) ***Similarity in political, economical and cultural environments:*** Especially, Southeast Asian countries and Korea have similarities to one another in political, economical and cultural environments. These countries are also precautious against the expansionism by some advanced countries.

Korea Telecom is in a peculiar position between developed and developing countries. From the developed, Korea Telecom needs to learn the advanced technology and managerial skills for its qualitative growth. That is, the company as well as the telecommunications market in Korea are providing attractive business opportunities for the developed. For the developing, it can contribute to the expansion of network infrastructure on the basis of its experience gained from its successful quantitative growth in the 1980s.

In conclusion, Korea Telecom should serve to bridge the gap between developed and developing nations in the world telecommunications industry with the spirits of cooperation and coexistence.

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An Exercise in Privatization: The Making of Telekom Malaysia

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1. ABSTRACT

The privatization of Malaysian government-owned and operated public services was a major aspect of the development agenda since the early 1980's. It was generally perceived by policy makers as the sine qua nom of the country's economic growth and the future development. Among the services initially earmarked for privatization were the transport and telecommunication sectors. This article takes a retrospective look at the Malaysian government's privatization policy with respect to the formation of Telekom Malaysia and explores the current and future telecommunication scenario vis-a-vis the biggest public-listing exercise in Malaysia's corporate history.

2. INTRODUCTION

An advertisement which regularly appears in Utusan Malaysia, a leading Malay-language daily, features a *tabib* (practicioner of traditional Malay medicine and other means of sex therapy) publicizing his services which purport to guarantee enhancement of men's sex life and general health. This particular advertisement would seem ordinary except that it carries the picture of the *tabib* clutching a cordless phone close to his ear. One can easily get this picture of a high-tech traditional medicine man at work. Blessed with this new sophisticated mobile phone, men from around the world, especially those afflicted with problems of a sexual nature, can now contact him almost instantaneously.

The above example reflects the vital role modern telecommunication plays in the day-to-day affair of the average Malaysian both in his private and public life. Even street hawkers nowadays take orders from their regular customers with the aid of mobile phone sets. And it is not uncommon especially for businessmen to be equipped with hand and/or car phones.

Indeed, with each passing day, new innovations accompained by a good measure of excitement, seem to color Malaysian telecommunication. Notwithstanding the availability of new and improved value-added services such as MAYCIS (Malaysian Circuit Switched Data Network) and MAYPAC (Malaysian Packet Switched Public Data Network), Telekom Malaysia's data communication services to commercial enterprises, *Telita* (videotext transmission), itemized customer billing and mobile telephony, last year (1991) witnessed events promising even bigger strides in the country's telecommunication development. Among them are:

i) The signing of the memorandum of understanding (MOU) held on the island of Langkawi which will pave the way for the launching of Malaysia's very own geosynchronous satellites in 1994. The satellites, known as Measat (or Malaysia East Asia Satellites) and costing U.S $250 million, are owned and operated by Binariang Sendirian Berhad, a Kuala Lumpur-based company. Built by America's Hughes Communications International Inc., Measat's satellites are expected to be launched in 1994 off Kourou in French Guyana by Arianespace of France;[1]

ii) The launching of the second phase of Telekom Malaysia's pilot ISDN (Integrated Services Digital Network) project. Initially to cover the populous Klang Valley in Peninsular Malaysia, ISDN systems are expected to be operational on a commercial basis in 1993. With the availability of ISDN -- where digitized voice, data text and images can be communicated via a single line -- Malaysia is poised to become the third country in Asia after Japan and Singapore to provide such sophisticated circuitry;[2]

iii) The completion and launching of a submarine optic-fibre cable link between Kuantan on the east coast of Peninsula Malaysia and Kota Kinabalu in East Malaysia. This optical-fibre link is expected to enhance the quality of telephone and broadcast transmission links between East and West Malaysia and support new services.[3]

The events, each a milestone in the development and expansion of telecommunication infrastructure and services in Malaysia, were largely viewed as being the manifestation of the deregulation and privatization policies adopted by the government in the early eighties in so far as the telecommunication sector is concerned. Deregulation of the telecommunications environment had also provided impetus for and entry of locally incorporated as well as foreign-based companies to compete for a slice of certain telecommunication services like pay and credit-card phones, mobile telephony, and paging systems. Competition among the telcos and having market forces decide their fortunes have generally brought about increased efficiency on the part of the telcos, enhanced their productivity and outlook, apart from sensitizing their staff to the importance of maintaining high-level customer satisfaction.

Rapid advancement in state-of-the-art telecommunications technology in the last two decades also dictated that the Malaysian government revamp the administrative structures and management function of Jabatan Telekom Malaysia (JTM), Telekom Malaysia's predecessor. JTM was the government department in charge of providing and upgrading telecommunication services and maintenance of infrastructure nationwide. Encumbered with administrative procedures and regulations, it was generally felt by policy makers that, as a government department, JTM would be in no positon to provide a viable network let alone run a profit-oriented telecommunication service for to the country.

Besides the rapid advancement of telecommunication technology, there were other conducive factors enabling the privatization of telecommunication services in Malaysia. These will be discussed in the following section.

3. PRIVATIZATION: THE BEGINNING

The impetus for the privatization of government-owned and operated public services had largely come from Malaysian Prime Minister Dr. Mahathir Mohamad when he assumed the mantle of leadership in 1981 from former Prime Minister Hussein Onn when the latter stepped down due to healt reasons. Dr. Mahathir initiated a series of Policy changes--often viewed as drastic by some at that time and with skepticism by his detractors--viz his Look East policy, emphasis on heavy industries, Leadership by Example and, of course, privatization coming almost simultaneously with the push for industrialization and export-orientation. Although critics had expressed reservations saying that "nepotism and corruption" can easily rear their ugly heads if privatization is not executed according to the book and done openly, it is generally felt that the majority of Malaysians do not want privatization stopped altogether as many consider their state-owned and run utilities inefficient.[4]

Ailing government corporations and obligations on the government's part to finance and provide for certain public services put a strain on the country's finances. The corporatization and, later, privatization, of these government entities were recognized as possible options to relieve the government of its financial burden and resuscitate some of its financially-strapped corporations and utility providers. Futhermore, the onslaught of recession in 1983 convinced the Mahathir Administration that the private sector should be accorded a bigger role in the provision of social services and amenities to the nation and hence reduce government expenditure on such services.

The Cabinet entrusted the Economic Planning Unit (EPU) of the Prime Minister's Department with the task of coming out with a comprehensive national privatization masterplan, one in which the government envisages should: "...enhance the role of the private sector in the economy while at the same time creating new opportunities for the public, in particular the employees of the privatised projects as well as the Bumiputera community to own wealth through the purchase of shares in these projects".[5]

3.1 PRIVATIZATION AND THE ROLE OF EPU

Privatization, by the end of the 1970's, was becoming an international catch-cry and Malaysia, which did not lose time in recognizing it as an instrument for spurring economic growth,

coopted it into its development agenda. The Economic Planning Unit (EPU) of the Prime Minister's Department set to work out the best possible privatization formula that took cognizance of the country's development goals and immediate priorities. Based on an analysis of two EPU publications focusing on the implementation guidelines of the policy,[6] privatization's major guiding principle can be summarized as follows: provision of strategic services in an efficient, profitable manner but without sacrificing public needs and/or, more importantly, jeopardizing the interests of the ruling political party.

Identification by the EPU of potential candidates for privatization got undersay in 1982. Among the earliest to be identified were the Malayan Railway, the Port Klang Container Terminal, National Padi and Rice Board's rice milling complexes and the Royal Malaysian Navy Dockyard located in Lumut. This was followed by the moves to corporatize and then privatize the National Electricity Board and Jabatan Telekom Malaysia. Up till the end of 1991 and since the formal implementation of the privatization policy in 1983, 37 projects have been privatized, 27 of which were once government entities but now taken over by private companies either through outright management buy-outs or by sale of equity or assets to the public. The government earned $U.S.437 million through sales of its interests in entities which it once owned and was financially relieved of some $U.S.3 billion when it need no longer has to foot the bill for costs of infrastucture development and operating expenses.

The EPU subscribes to two other basic types of privatization implenentation methodology: "Build-Operate-Transfer" (BOT) and "Build-Operate" (BO). The BOT concept requires interested companies to submit proposals. If approved, the company then constructs the facility with its own funds but is allowed to collect revenues from users over a specific period of time. The construction of highways and collection of toll is an example of this. The BO scheme is largely similar to BOT but the company concerned does not transfer its assets or facility to the government. An example of BO is Sistem Televisyen Malaysia Berhad (STMB). Granted a license by the Ministry of Telecommunications, Post and Energy in 1985, it now operates a private commercial TV station (TV-3) nationwide. STMB's ownership, however, is closely linked to the investment arm of UMNO or United Malays National Organization, the major component of *Barisan National*, the ruling calition, as well as, to other organisations linked to the other leading political parties in the coalition.

Besides recommending government entities for possible privatization to the Cabinet, the EPU also reviews proposals from various private companies keen to take over state-owned and operated entities. The process, as illustrated in Figure 1† also at times involves the appointment of consultants to undertake a feasibility study once a proposal is submitted via the EPU to the Cabinet. Based on consultants' appraisals and recommendations, the Cabinet would then seek passages of legal amendments to existing statutes like the Pensions Act of 1980, the Telecommunications Act of 1950 and the Electricity Act of 1949 so as to facilitate the smooth transfer of government, assets and the profitable management of services by private companies that are established under the Companies Act of 1965.

Proposals to buy out or take over the running of state-owned services must take cognizance of the objectives of Malaysia's privatization policy, viz

a) relieve the financial and administrative burden of government;

b) improve efficiency and productivity;

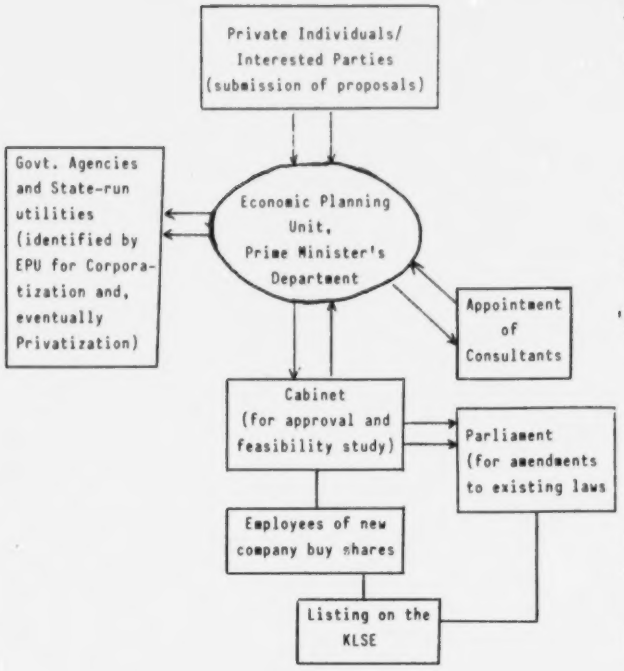
c) facilitate economic growth;

d) reduce the size and presence of the public sector in the economy; and

e) help meet the national economic policy targets.[7]

Reflective of the policy objective as mentioned in (e), privatization also is seen as an instrument to enhance Bumiputera (indigeous) equity stake and increase their participation in the corporate sector. Apart from this, employees of newly-privatized entities will stand to gain from higher remuneration and benefits concomitant to the implementation of various incentive schemes which otherwise are not usually found in government enterprises. They can own a part of the company through such schemes as the Employee Share Ownership Plan (ESOP) and Management-Employee Buy-Outs (MEBOs) as prescribed in the privatization masterplan.

(*See next page)



Steps in the Privatization Process

1. Identification by the EPU of state-owned and run utilities and services for possible privatization;
   Proposals submitted by interested parties to the EPU.
2. Analysis, Review and Recommendations by EPU to the Cabinet.
3. Cabinet approval; appointment of consultants.
4. Cabinet proposes new laws and amendments to existing statutes for passage by Parliament.
5. New company/corporation set up under the Companies Act of 1965 to take over ownership/management of state-owned and operated agencies/utilities.
6. Sale of shares to Employees.
7. Prospectus and sales of shares to the public.
8. Listing on KLSE.

Fig. 1 Major Entities and Steps in the Privatization Process

As for foreign ownership, certain conditions prevail, particularly in terms of the value and amount of equity held in a company, which must not be in the majority. Foreign ownership is allowed only if its:

a) expertise is needed to upgrade efficiency and such expertise is not available;

b) participation is necessary to promote the export market;

c) purchase of shares will help supplement the supply of local capital; and

d) participation will enhance global linkages and international exposure.[8]

The next section takes a look at the biggest transfer exercise of public assets and services to a largely government-owned company as well as the largest public listing in Malaysia's corporate history. It also offers a brief assessment of Telekom Malaysia's performance besides exploring the company's prospects in the near future.

4. TELEKOM MALAYSIA: PERFORMANCE AND PROSPECTS

The Malaysian telecommunications environment was poised to enter a new era of growth and expansion when, in 1987, the government transfered JTM's assets and operations to a corporation known as Syarikat Telekom Malaysia (STM).[9] The transfer not only hightened public expectations at home, it also attracted the attention of foreign investors. Malaysians, not unlike the foreign investors, expected an overall improvement to their telecommunication services, albeit, shorter waiting periods for telephone installations.

Apart from this, an important pre-requisite to more foreign investments into the country, the government knows, is an efficiently-run and up-to-date infrastructure and related services. The desire to enhance connectivity to the transnational corporate structure and the international marketplace meant the creation of a carrier unshackled by cumbersome government procedures and capability to keep pace with modern information and communication technology.

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Hence, the inertia to inevitably privatize JTM.

4.1 FLOTATION OF TELEKOM MALAYSIA SHARES

After three years of "corporatization" characterized by steady growth, STM was ready to have its shares listed on the Kuala Lumpur Stock Exchange (KLSE).[10] A total of 470.5 million new ordinary share--representing 23.8% of the corporation's issued and paid-up capital--was floated in September 1990. The issue price was M$5.00, or roughly $U.S.1.80, which was thought to be fairly high for an introductory issue. At the end of the day, the sale of its shares was oversubscribed by only 1.5 times, a figure far below what industry analysts had expected. Hesitations were largely blamed on uncertainties in the Middle East (Iraq's invasion of Kuwait) and Malaysianstypically saving up for incidental end-of-year expenses.

In line with the government's policy of increasing indigenous equity stake, Telekom Malaysia reserved slightly more than 30% of the issued shares to Bumiputra-related institutions and individuals. Five-percent were allocated to foreigners while another 15% were meant for its employees and eligible employees of JTM. Through what was known as "pink forms", employees, nearly all of whom had opted to serve with Telekom Malaysia, were privileged to purchase their company's shares. Almost all did but some resold them in order to make quick gains when Telekom Malaysia share price went up to U.S.$2.40 per unit on the KL bourse. This unforseen behavior on the part of the employees later led to the Economic Planning Unit to coopt the Employee Share Ownership Plan (ESOP) to its privatization policy. ESOP involves the setting up of a trust to hold shares for employees. Under such a scheme, employees can only sell their shares when they leave the company or when they retire.

Based on Telekom Malaysia's 1990 Annual Report, the government of Malaysia, through a body corporate established under the Minister of Finance (Inc.) Act, 1957, holds 76% or close to 1.5 billion of Telekom Malaysia shares while, individuals from Malaysia make up 3.3% of the shareholders, and foreigners 3.7%.
(see Appendix 1)

4.2 TELEKOM MALAYSIA'S PERFORMANCE: AN OVERVIEW

If profits are any measure of Telekom Malaysia's performance, then the telecommunication behemoth is, indeed, a succeess story. Telekom Malaysia has in the last three years been viewed and recognized as a national phenomenon; the flagship of the government's privatization policy. Figure 2 indicates the extent of Telekom Malaysia's steady gains in its pre-tax profits since corporatization in 1987. Since then, the government has, as an incentive, not taxed Telekom Malaysia earnings and this, analysts say, was one stabilizing factor of the company's share price on the KLSE. Once an actively-traded counter, Telekom Malaysia share price rose to a high of U.S.$4.50 in May 1991 only to ease off at U.S.$3.70 at the end of the year, far below that of U.S.$7.40- a price analysts predicted the shares could fetch but never did. Nonetheless, the company expects to achieve a pre-tax profit of U.S.$370 million for 1991.[11]

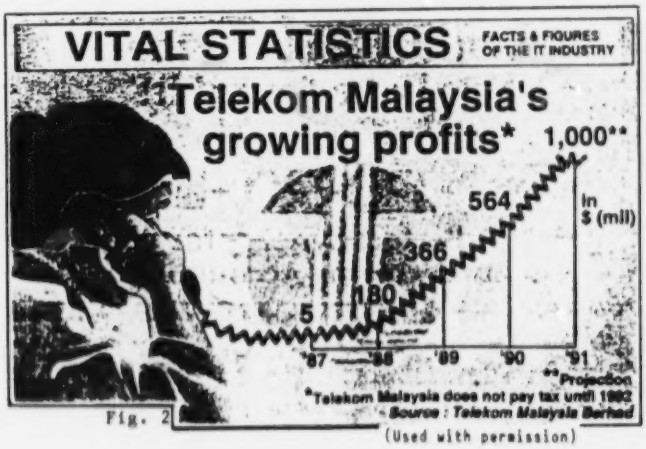

Fig. 2

Notwithstanding the availability of an array of digitized data communication services as well as domestic and international toll-free dialing, waiting period for phone installation has also been cut from six months to roughly two weeks since the company's inception in 1987. Telephone density per 100 inhabitants, too, has risen from 6.8 in 1982 to 9.2 in 1991. With steady increases in line installations, the company expects to increase density to 25 by the year 2000, thereby inching Malaysia closer to the ratio achieved by developed countries. Hopefully, services, expecially residential telephones, will be equitably spread nationwide.

As for now, telephone density and various other value added services are concentrated in major cities. Those in rural areas (where density is two per 100 inhabitants) often complain of difficulties of access to good, working telephones. Despite the shortcomings, it is, however, heartening to note that Telekom Malaysia is setting aside U.S.$630 million to expand and upgrade rural telephony during the Sixth Malaysia Plan period (1991-1995). And over the same period, too, about U.S.$3.70 billion worth of capital investments will be made mostly by Telekom Malaysia to upgrade and maintain telecommunication's infrastructure in Malaysia, making it one of the fastest and largest growth market for telecom equipment in the Asia-Pacific region.[12]

5. CONCLUSION

We are said to be moving into the Information Age--an era characterized by the synergy of tele-communication technologies and computers continually transforming the manner, speed and volume by which data, voice and images are communicated across the globe. The rapid advancement in communication and information technologies especially in the last two decades had necessitated a re-examination of policies both in developed and developing countries and the fine-tuning of regulatory frameworks governing their use.

In Malaysia, apart from the rapid advancement in telecommunication technology, other factors spurred the privatization of the country's telecommunication services:

i) the need to enhance connectivity to the transnational corporate structure and the global marketplace,

ii) government's own need to relief itself of the burden of expenditure on public utilities,

iii) the need to raise indigenous ownership of the corporate wealth of the country.

One of the bigger challenges to Telekom Malaysia in the course of its privatization is the maintennance of a proper balance between an efficiently-run, profit-oriented company and commitment to social needs and public interest. As for the former, Telekom Malaysia has proven itself reasonably well judging from:

i) steady increases in profits made since its inception,

ii) its shares are actively traded and are viewed by industry analysts as growth utility stock and

iii) its ability to settle outstanding loans particularly from the 1990 floatation exercise.

As for meeting social needs, much is left to be desired. Rural telecommunications is in dire need of improvement let alone expansion and much of the advanced services are urban-centered, mostly catering to the needs of the mercantile community. However, the educational sector is neglected and it is felt that Telekom Malaysia should chart a more visible and active role toward enhancing education via use of its own array of telemedia delivery systems. Academicians in the country feel that the new video teleconferencing facility which Telekom Malaysia plans to introduce in the foreseeable future will cater more to the needs of the corporate world. What is needed is close cooperation between Telekom Malaysia and institutions of higher learning so that a strategic plan could be worked out for effective utilization of its systems in order to enhance distance learning and telelectures by videoconferencing and production of knowledge-based software.

In their study of ASEAN's telecommunication policies and trends in infrastructure development, Hukill and Jussawalla (1991) felt that network expansion is bound to put pressure on traditional culture as Westernization gets the better of the Malay/Muslim values and this could be destabilizing to Malaysia's multiracial polity![13] While this may be a legitimate concern but this writer, going to the story of the *tabib* with which he began this paper, is inclined to believe that what is important is the harmonious blending of modern technology and the utilization of new information and communication technologies to suit local needs and values. The case of the *tabib* traditional Malay medicine man serve to illustrate this point.

With expanded networks and the globalization of telemedia delivery systems, Telekom Malaysia should cooperate more closely with the local entertainment and cultural industry and play a pivotal role to balance out the flow of cultural, knowledge and information-based product--which

have always been in favor of the developed Western countries--at least within the Asia-Pacific region.

The telecommunications sector in Malaysia is poised for further expansion as the nation's economy continue to show signs of stable growth. Telekom Malaysia is expected to play a pivotal role in the nations economic development as the nation aspires to become a significant player in the international marketplace and achieve developed country status in the year 2020.

FOOTNOTES

1. See: "Signed: $675 million deals for our 1994 satellite launch" in New Straits Times, November 6, 1991, p.1-2.

2. See: "Telekom begins second phase of ISDN project" in Computimes (New Straits Times), May 30, 1991, p.1.

3. See: "Five new services in two years" in Computimes (New Straits Times), November 14, 1991, p.15.

4. See: "In Malaysia, Dial 'P' for Profit" in Asiaweek, September 15, 1989, 57-63.

5. See: "Foreword" by the Prime Minister of Malaysia, Dr. Mahathir Mohamad, In Privatization Masterplan, Kuala Lumpur: Economic Planning Unit, Prime Minister's Department, (February, 1991).
The term *Bumiputera* refer to indigenous Malaysians who are predominantly Malays and original residents who are descendants of the various tribes of the East Malaysian states of Sabah and Sarawak. Malaysians of Chinese and Indian origins are not usually classified as *Bumiputeras*.

6. The documents are: Guidelines on Privatization (1985) and Privatization Masterplan (1991)

7. Privatization Masterplan, *op. cit.* p. 21.

8. Privatization Masterplan, *op. cit.* p. 27.

9. Syarikat Telekom Malaysia (STM) was incorporated on October 12, 1984 under the Malaysian Companies Act of 1965. On January 1, 1987, STM officially took over the operations of Jabatan Telekom Malaysia (JTM) under license issued by the Ministry of Energy, Telecommunications & Post. Coinciding with the September, 1990 flotation exercise, and as a strategy to enhance its image internationally, STM's management decided that the company was to be simply called Telekom Malaysia thereafter, and adopted a new corporate logo as well.

10. The listing on November 7, 1990 of Telekom Malaysia's shares was the first and biggest flotation exercise by a major public utility on the KLSE. It raised some U.S.$870 million for Telekom Malaysia and was expected to increase the market capitalization of KLSE by about U.S.$3.7 billion.

11. See: "Telekom on course to score billion" in New Straits Times, July 26, 1991, p.14.

12. See: "Investment in Telecommunication Projects to exceed $10 billion" in The Star, November 11, 1991, p.7.

13. Hukill, Mark A. and Jussawalla, Meheroo. (1991). Trends in Policies for Telecommunication Infrastructure Development and Investment in the ASEAN Countries. Institute of Culture and Communication, East-West Center, Honolulu, Hawaii.

APPENDIX 1

LOCATION OF TELEKOM MALAYSIA'S SHAREHOLDERS

TYPE OF OWNERSHIP	SHAREHOLDERS	%	SHAREHOLDINGS	%
COMPANIES IN MALAYSIA				
NOMINEES COMPANIES	28	0.0660440	99,753,000	5.0623192
BUMIPUTERA CORPORATION	24	0.0566091	49,204,435	2.4970533
OTHER COMPANIES	207	0.4882536	4,588,000	0.2328343
MALAYSIA RESIDENTS				
MALAYS	21,929	51.7242195	37,183,000	1.8869830
CHINESE	16,831	39.6995000	22,398,000	1.1366658
INDIANS	2,921	6.8898009	5,462,000	0.2771885
OTHERS	347	0.8184734	920,000	0.0466887
GOVERNMENT AGENCIES	28	0.0660440	1,677,371,566	85.1241598
MALAYSIA TOTAL	42,315	99.8089445	1,896,880,001	96.2638926
COMPANIES IN SINGAPORE				
NOMINEES COMPANIES	25	0.0589678	68,884,000	3.4957625
OTHER COMPANIES	3	0.0070761	1,000,000	0.0507485
SINGAPORE RESIDENTS	44	0.1037833	185,000	0.0093884
FOREIGN INVESTORS				
BRITISH	1	0.0023587	1,000	0.0000507
HONG KONG	2	0.0047174	2,827,000	0.1434661
AUSTRALIANS	2	0.0047174	8,000	0.0004060
AMERICANS	1	0.0023587	700,000	0.0355240
CANADIANS	1	0.0023587	9,000	0.0004567
OTHERS	2	0.0047174	6,000	0.0003045
FOREIGN TOTAL	81	0.1910555	73,620,000	3.7361074
GRAND TOTAL	42,396	100.0000000	1,970,500,001	100.0000000

Source: Telekom Malaysia Annual Report, 1990

PRIVATIZATION OF TELECOMMUNICATIONS FACILITIES IN THE PHILIPPINES

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1. ABSTRACT

Policies of the Philippine Department of Transportation and Communications recognize the private sector as the key to development of the telecommunications sector. This paper overviews the experiences of the Philippines in their first privatization exercise of telecommunications facilities. The paper describes the unique aspects of the telecommunications sector in the Philippines and the objectives of the government in establishing a privatization program. It also addresses related issues of funding, of support to private companies and of transferring facilities to a private sector characterized by a dominant operator and a number of small operators.

2. THE PHILIPPINES TELECOMMUNICATIONS SECTOR

The current telecommunications infrastructure displays an imbalance in the distribution of telecommunications facilities which leads to services that are concentrated in Metro Manila, selected cities and urban centers in the country. On the national level there are only 1.6 telephones per 100 people while in Metro Manila the development is 9.6 telephones per 100 people. There are 920,000 telephones installed with approximately 80% located in the Metro Manila area and the remaining 20% distributed in other municipalities. Telephone service is inadequate and of poor quality especially in the countryside. Characteristically, there is an inability of the private and public sector to obtain attractive financing to fund the required network construction and the much needed service improvements.

The Philippine Long Distance Telephone Company (PLDT) currently dominates the industry with approximately 95% of the market share. An additional 67 private companies are interconnected to PLDT's network. A number of other operators provide non-interconnected services.

The Department of Transportation and Communications (DOTC) is the government agency responsible for formulating national policies pertaining to the development of telecommunications systems in the Philippines. DOTC implements plans and policies through the National Telecommunication Commission (NTC). All domestic and international telecommunications services are governed by DOTC directives and pronouncements. In particular, DOTC is empowered to formulate and recommend national policies and guidelines for the preparation and implementation of an integrated and comprehensive communications system at the national, regional and local levels.

The National Telecommunications Commission (NTC) is the agency within DOTC which carries out the DOTC policies and responsibilities. The NTC supervises, regulates and controls all telecommunications services in the country including approval and supervision of all expansion and modernization projects, regulating private investment in telecommunications equipment and systems, setting and enforcing rates and technical standards, allocating frequencies and issuing operating permits. The NTC has quasijudicial powers which can only be appealed to the Supreme Court. NTC is also empowered to exercise supervision and control through its organizational units and regional offices.

The Telecommunications Office (TELOF), a government agency created under DOTC, is the chief operating agency of the government for telecommunications. Its main functions are: (a) To develop, formulate and recommend plans, policies, programs, standards, specifications and guidelines for providing telecommunications facilities including telecommunications systems for purposes of augmenting limited or inadequate existing private telecommunications service; and (b) To provide telecommunications services in areas

where no such services are available. TELOF's main operations are a nationwide telegraph system and 27 rural exchanges.

3. THE PRIVATIZATION PROJECT

3.1 BACKGROUND

The Telecommunications Policy Directorate (TPD) of the Department of Transportation and Communications (DOTC) has undertaken to implement policies which recognize the private sector as the key to development of the telecommunications sector. An important element of this policy is Department Circular 90-252 which mandates the ultimate privatization of all government owned facilities.

A first initiative in this area was the privatization of Phase A of the Rural Telephone Development Program RTDP(A). Subsequently, further privatization efforts were identified for Phase B (RTDP-B) and Phase I, Tranche 1 of the National Telephone Development Program (NTPI-1).

RTDP(A) is an operational system providing 11,000 lines and associated exchange and toll services to subscribers in northern Luzon. The system is owned by the government and operated under contract by a private company, Filphone. RTDP(B) will add 8000 lines to the RTDP system, while NTPI-1 will provide approximately 50,000 lines and associated toll facilities in regions 3 to 5.

The Regional Telecommunications Development Project and the National Telephone Development Program were conceived by the Government of the Philippines with the primary objective to correct the disparities in the local socio-economic status between the rural and urban settlements and to uplift conditions in the rural areas of the country through effective communications systems. Both the RTDP and NTP facilities were funded through the Overseas Economic Cooperation Fund of Japan.

3.2 OBJECTIVES

At the outset, the government established these objectives for privatization:

a) To improve the financial return to government over what it would realize from operating the facilities through a government agency.

b) To ensure viability of the operator who eventually acquired the facilities.

c) To encourage service expansion after the transfer of facilities.

d) To encourage the long term modernization of equipment and provision of new services.

3.3 ORGANIZATION OF THE PRIVATIZATION PROJECT

The organization, adopted by the DOTC to carry out the privatization project, is illustrated in Figure 1.

DOTC Prequalification and Award Committee: This Committee is comprised of Senior DOTC officials along with a member assigned from a nonGovernment industry association. Under Philippine law, the committee is an officially designated body which defines the terms of reference for a project, oversees the prequalification of prospective bidders and is ultimately responsible for the review and selection of the bids.

Advisory Group: An advisory group with representatives from the Philippine Association of Private Telephone Companies and the National Telecommunications Commission (NTC), advised on the criteria for prequalification and other matters such as the rationalization of exchange serving arrangements.

Subcommittees: The DOTC financial and technical subcommittees developed the prequalification procedures and methods for the evaluation of submissions. In addition, the working subcommittees did the actual evaluation of the financial, technical and management bid submissions.

Consultants: Consultants were provided by the United States Agency for International Development (U.S.A.I.D.) and the Asian Development Bank ADB.

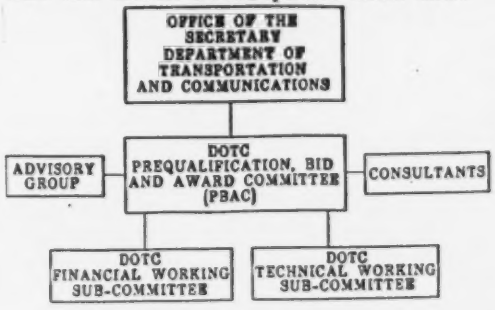
OFFICE OF THE SECRETARY DEPARTMENT OF TRANSPORTATION AND COMMUNICATIONS
ADVISORY GROUP
DOTC PREQUALIFICATION, BID AND AWARD COMMITTEE (PBAC)
CONSULTANTS
DOTC FINANCIAL WORKING SUB-COMMITTEE
DOTC TECHNICAL WORKING SUB-COMMITTEE

FIGURE 1
DOTC PRIVATIZATION PROJECT
ORGANIZATION
REPUBLIC OF THE PHILIPPINES
1991

3.4 WORK UNDERTAKEN

The privatization work began in mid 1990 when the DOTC formally announced its plans to divest of all of its telecommunications operations. RTDP (A) was identified as the first system to turn over to the private sector. The RTDP (B) and NTP I-1 were soon added. Following is a brief description of the work undertaken to date by DOTC:

Prequalification: DOTC, with input from industry and the NTC, established criteria for companies to take over the government owned systems. Submissions were solicited and the DOTC received responses from 8 companies. 5 companies were prequalified. The basis of prequalification was the demonstrated financial and technical capability of the companies to assume operation of the government systems. Regulatory authorization was not a requirement.

Asset Valuation: A detailed asset valuation was carried out on the RTDP (A) facilities, which included estimations of replacement cost and depreciated value. A detailed field study was not conducted of RTDP (B) and NTP I-1 as these systems were not yet installed. However, information was gathered from the contracts for these systems on the quantities and types of equipment, and on the value of these systems.

Financial Strategy: A report was prepared which outlined the options for sale and lease of assets. The report presented different lease structures of upfront payments, revenue based payments and capacity based payments. The intent of the report was to present the benefits of various options to DOTC as an input to structuring the bid documents.

Development of Bid Documents: Bid documents were produced instructing bidders on the content and structure of bids to be submitted to DOTC. The documents included bid instructions and requirements, a description of the assets being bid, a proforma contract, operational and technical requirements to be assumed by the successful bidder, and the required structure of their financial proposals.

Asset Value/Cash Flow Analysis: Two studies were undertaken to assess the value of the facilities being bid. The studies took two approaches. One approach assessed the fair market value of the assets. The second approach calculated the net present value of the expected excess cash flow from private operation of the system (as compared to government operation). The studies tested various sensitivities such as economic life, discount rate, revenue growth and operating efficiency. The studies were the main input to establishing a "floor price", the minimum bid offer, acceptable to DOTC.

Bidders Conference: A conference was held immediately following issuance of the bid documents. Prospective bidders were invited to comment on the bid documents and seek clarification of the bidding process. The conference was followed by a formal written response from DOTC to all bidders which provided additional information on the issues raised at the conference. In addition, a technical working session was arranged following the conference. At this session, technical representatives of the bidders were provided with system drawings, equipment lists and other technical documentation held by DOTC which could assist bidders in preparing their bids.

Bid Evaluation: Four bids were received. The technical and management proposals were evaluated by the Technical Working Committee according to predetermined evaluation criteria. They found all proposals to be compliant and recommended acceptance to the committee. The financial proposals were evaluated after completion of the technical evaluation and following a public opening of the financial offers. The financial evaluation was undertaken to confirm that there were no errors in calculation or misunderstanding of the financial offers of the bidders. Two companies submitted bids which exceeded the minimum acceptable price established by DOTC (the "floor price"). As of this writing, a final detailed financial review is underway.

4. ISSUES AND OBSERVATIONS

4.1 THE BIDDING PROCESS

A two envelope bidding procedure was used. The technical and management proposals were submitted in separate envelopes from the financial proposals and evaluated as follows:

- On the date of submission, the proposal submissions were checked for content in the presence of the bidder at a public meeting.
- The technical and management proposals were opened at the same public meeting and verified by the committee. The financial proposals and

bids were not opened but securely stored until completion of the technical evaluation.

- The technical proposals were evaluated and judged as to their technical compliance by the technical working committee. The results of the evaluation were considered by the committee and the bidders notified of the findings.

- Financial proposals were opened at a second public opening and the bids posted. Financial proposals were subsequently evaluated for compliance.

This bidding process worked well. Firstly, evaluation of the technical proposal not only established the technical capability of the bidder, but it committed the bidder to meeting certain technical and operational requirements.

Secondly, the simple "pass/fail" evaluation of the technical proposals (as compared to assigning a "score" for a qualitative ranking of the proposals) simplified the process and removed much of the subjective judgement from the evaluation. The determination of the best bid was based entirely on who offered the best (highest) price.

Finally, the two step evaluation provided DOTC the opportunity to seek clarification of the technical offering of a bidder, prior to opening the financial proposals.

4.2 REGULATORY REQUIREMENTS

An important requirement was to make bidders assure DOTC of their responsibility for executing interconnect and revenue sharing agreements with adjacent operators ensuring full interconnection to the PSTN. In addition, DOTC solicited and received agreement from PLDT to continue existing interconnect and revenue sharing agreements with the winning bidder.

To include bidders who were not franchised, licensed or otherwise authorized to operate a telecommunications undertaking, the bid process allowed for an optional "operations and management" contract. This was to exist for an interim period until the selected bidder obtained regulatory approval and could enter into the preferred "financial lease" agreement.

The inclusion of non-franchised bidders through the use of an interim "operations and management" contract was for the purpose of enhancing competition among the bidders to bring out a final proposal that would be the most advantageous to the Government, the taxpayers and the telephone subscribers in question.

4.3 ACCOMMODATION OF EXISTING LOCAL OPERATORS

The intent of the bid process was to turn over all privatized facilities to a single operator. However, there was a requirement to accommodate smaller operators who had previously established themselves as the service provider in exchange areas where the government has installed, or plans to install facilities destined for privatization. A further consideration was the stated policy objective of having a single operator in any given local exchange area.

To ensure there would be only one operator per local exchange, the bid process provided a "right of first refusal" whereby existing operators will be given the opportunity to acquire privatized facilities in their exchange area. The bid documents have identified those exchanges where operators currently exist and has removed them from the bid process. The bidders have been instructed that the government will negotiate separately with the small operators for those facilities, but if the small operator cannot agree, the winning bidder will be obligated to take over those facilities.

Consideration of the private operators was a difficult but very important aspect of the bid process. Accommodating these operators greatly complicates the privatization of facilities as many separate contracts will be required. Also, the operators themselves will require agreements on interconnection, revenue sharing and joint operation of certain facilities. However, they must be accommodated as in many cases they are the establish service provider and are protected by their regulatory approval to continue.

4.4 LEASE STRUCTURE

As restrictions by the funding agency denied an outright sale of facilities, a "financial lease" was selected as the preferred form of agreement for transferring operation of the facilities to a private company.

The components of the lease, which the bidders were instructed to bid on include:

- An upfront payment
- An annual lease payment for the privatized facilities, stated per line of installed, operational capacity.
- A transfer payment at the end of the lease.

The bid proposals were evaluated on the net present value (NPV) of these three payments, with two additional constraints. Firstly, the upfront payment had to be no less than 25% of the first annual payment, and secondly, the present value of all payments had to exceed a "floor price" set by the government prior to accepting bids, but not made public until the bid opening.

A 30 year lease term was selected as this aligned with the repayment period of the loan, under which the facilities were procured. Other issues considered in structuring the lease were:

Incentives: Attempts were made to build in incentives for capital investment, system maintenance and personnel efficiency. All were abandoned for reasons of administrative difficulty or simply as being contrary to the philosophy that a qualified, private sector company can best operate a telephone system with a minimum of interference. The incentive which was given most serious consideration was the "capital investment fund". The concept was to have a portion of the lease payments deposited in an escrow account, to which the operator could apply for capital expansion projects. It was concluded the likely amounts available to the fund would not justify the administration requirements.

Revenue Based Lease Payments: Consideration was given to basing the annual lease payments on revenue, instead of capacity. This approach offered the advantage of allowing the government to share in the benefits of a successful operation (capture of so called "super profits"). It was also seen as a way to limit the risk of the operator should the system not perform to expectation thereby increasing the quality of the bids. However, revenue based payments were rejected as the accounting verification of revenues was seen as difficult and subject to misrepresentation. Moreover, high profits are limited by NTC limitations on the return on investment available to an operator.

Government Equity Participation: Mechanisms for government equity participation were considered, including joint venture arrangements, government stock options and government board participation. It was decided to not seek equity participation so as to minimize government involvement in the affairs of the operator.

4.5 OTHER ISSUES

Labor Issues: Alternative arrangements for the employees of Filphone (the company contracted to operate the RTDP phase A system) were considered in the bid process. One option was to obligate the winning bidder to employ personnel who were operating the system. However, agreement was sought and received from Filphone that they would continue to provide employment (with mutual agreement of the employee) for their employees.

Land Rights: Much of the land and right-of-ways acquired for the RTDP and NTP facilities has been donated or leased by local governments. It was decided to continue these agreements on behalf of the winning bidder, until such time as they can conclude their own agreements.

Ownership of Added Facilities: An important principal of the privatization exercise was that bidders would be asked to bid on a long term business opportunity not on a collection of equipment, buildings and facilities. In return for the right (in most areas, the exclusive right) to operate, the operator was obligated to provide public services, to expand and to modernize that is, to add facilities of their own. It

was clear that within 10 to 15 years, virtually all government facilities would be beyond their economic life. In the event of early termination of the lease, the issue of who owns which equipment could be a difficult one. It was agreed that ownership would be assessed on the depreciated value of the assets provided by each party to the system.

5.0 CONCLUSIONS

It has been just over one year since the Philippines undertook this first privatization project. For those considering a similar venture, here is a summary of the lessons we have learned:

- Establish Objectives. There are many reasons to privatize introducing organizational change, accessing new capital markets, accessing technology, etc. The objectives need to be clearly formulated, articulated and kept visible throughout the project.

- Organize. Privatization involves many government departments, agencies, companies and private sector organizations. Pulling together the right people, vested with the necessary authority is essential to overcome the inevitable politics.

- Maximize Competition. Open the bidding up to as many qualified companies as possible. Encourage outsiders.

- Consider Regulations. Moving to private operations will require an effective regulatory framework and an effective regulator. These need to be considered at the time of privatization as the strength and sophistication of regulation will often limit the structure of the privatized sector.

- Simplify the Bidding. Payment mechanisms, incentives, profit sharing and so on should be kept simple. Avoid downstream requirements for special accounting and monitoring systems.

- Consider the Issues. There are a number of side issues (such as labor, land use, etc.). These should all be considered upfront in the bidding process. This avoids contractual problem later in the process.

6.0 ACKNOWLEDGEMENTS

The author acknowledge the assistance of USAID, The Asian Development Bank, the World Bank and the Canadian International Development Agency, all of whom have providing consulting assistance to the project. Their ongoing support has contributed greatly to the success of this work.

THE TELECOM GAP:
THE IMPACT OF COMMUNICATIONS TECHNOLOGIES ON DEVELOPING ECONOMIES

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A sophisticated communications infrastructure can drive economic, political, and social progress. Unfortunately, many developing countries lack such as infrastructure. Bridging the Telecom Gap requires identifying both the critical elements which make communications necessary to developing countries and the obstacles communications companies face when building operations in these countries.

Technology, in general, and communications technology, in particular, are changing the way we live and work. We're living in one of the most pivotal periods in world history. When historians look back at this time, they'll most likely contend that we were part of an almost-silent, certainly-bloodless revolution -- a revolution fought with ideas rather than guns, a world war against the elements that would deprive the world of its access to technology and information.

History will record this period as being the beginning of an era in which virtually everyone has access to technology. The era dawned with the introduction of radios, telephones, and televisions into people's homes and businesses. But it really began to grow ten years ago when IBM put the first personal computer on a desktop.

In 1981, that was a marvel. Today, it's frustrating. We want more memory, faster processors, higher resolution monitors. And we'll get what we want. PCs will probably be replaced by pocket computers that we'll carry around with us everywhere we go. With microchips thousands of time smaller than we have today, and with fold-up keyboards that are linked to home-based personal computers, these pocket PCs will surpass the power even of today's mainframes.

They'll monitor our blood pressure and pulse rate. They'll determine peak periods for physical activity and creative tasks. They'll handle our administrative chores while we spend time thinking. Frankly, we can't even imagine some of the things they'll end up doing for us.

Similarly, the car phone will probably be supplanted by the wristwatch phone. It will follow us anywhere in the world, incorporating features such as voice mail and extensive memory for phone numbers and other rolodex information. It'll find us wherever we are -- in Cincinnati or Cancun or Lagos, Nigeria.

In one way, the world will become a smaller place. Because there will be practically no place we can go without staying in touch. On the other hand, the world will be a larger place, because we'll be able to go practically anywhere and still stay in touch.

The historical significance of this period, then, is likely to be that the limiting concept that divided the globe into first, second, and third worlds will be obsolete. There will be only one world -- one first world -- in which we are all linked by a global highway of information. It's already happening. We're living in an era in which instantaneous communications have created a global financial market. Our economies and technologies are so inter-connected that we're transacting more than $1 trillion worth of business on-line, every day.

Companies no longer need to concentrate their offices or plants in the U.S. or even in major cities because they now have massive private communications networks that span the globe. Ford Motor Company, for example, operates 23 high-speed voice and data lines that support 100,000 computer terminals and 95,000 employees. This network enables managers in Ford's Hermosillo plant, where the company builds Escorts, to talk with designers in London, lawyers in Washington, or executives in Detroit.

In fact, corporate voice, data, and teleconferencing traffic among different countries is soaring by 15% - 20% a year, about double the corporate rate in the continental U.S. In October 1991, the *Wall Street Journal* predicted that international traffic will grow by at least 12% a year to more than $14 billion annually by the end of the decade. These examples illustrate the extent to which telecommunications has reshaped the business world, particularly in developing countries.

American Airlines now earns more revenue from its computerized reservation center than from its traditional airlines business. And that reservation center is not in New York or London or Paris. It's in the Dominican Republic.

Data entry companies -- owned, operated, and staffed by nationals -- are experiencing extraordinary growth in places that a few years ago would have seemed unlikely, such as Jamaica, Barbados, Thailand, and Malaysia.

As recently as five years ago, a company like CBIS could not have justified a multi-million dollar investment in a new data center in Mexico. Today, that justification is easy to make; the market demand for data services in Mexico -- and throughout much of Latin America -- is skyrocketing. We see our investment in Monterrey as a major opportunity to get in on the ground floor of a rapidly-growing marketplace.

In one country after another, we're seeing the payback that comes from investments in the communications infrastructure. Benefit/cost ratios in countries such as the Philippines and Costa Rica have been established at 5/1 and, in some sectors, even 48/1. The Bell Operating Companies commissioned a similar study of telecom's economic impact in the U.S. They found that, even in the U.S., with its sophisticated network, telecom advancements had saved the economy more than $80 billion during a 20-year period.

But even with the support of such overwhelming evidence, developing countries still face major questions each time they consider modernizing their telecom sectors. For example, it's obvious that the global network has become the arterial system that links our worldwide economy together. But can that network -- particularly in developing countries -- keep up with user demands and traffic volume that are increasing exponentially year after year?

As the global network becomes so critical -- and so sophisticated -- developing countries have to make major telecom investments if they're to achieve their economic development goals. But can these countries justify such investments when they have so many other pressing needs, including housing, health care, and education?

Some people advocate deregulation and privatization as a way to address these issues. Clearly, privatizing state-owned companies and encouraging competition often generates the capital and momentum necessary to build a modern communications industry. But can developing countries embrace these options and still ensure that areas outside the urban business centers have access to telephone service?

The answer to all these questions can be a resounding 'yes.' But only if all of us -- the wireline carriers, the non-wireline carriers, and the vendors who support your industries -- recognize the important roles we each play in building the communications infrastructure.

WIRING THE WORLD—AGAIN!

Consider how the "wired world" has driven economic growth and how the "wireless world" is now helping to sustain that growth.

A key component of economic growth throughout the world has always been a country's transportation infrastructure. The industrial revolution is a good example. Its mushroom-like growth was sustained because the industrializing countries embarked upon massive public works projects, building roads and bridges and canals. The British navy was the catalyst that enabled Britain to grow into the largest empire in history. U.S. railroads in the mid-19th century and its interstate highway system in the mid-20th century contributed greatly to the United States' phenomenal growth.

Again and again, transportation has been the critical link that enabled commerce to flourish. And it's still important; from the shipping industry to the growing courier industry, the need to move materials and products and packages is as great as ever.

But in addition to traditional means of transport, there is also the need to move an incredible volume of information -- not just from region to region but from continent to continent. And not just from day to day but from second to second.

Information has become the most critical business commodity in the world. We're at a point in history not unlike that faced by business half a century ago when the world was being wired for the first time -- not for information but for electricity. During that period, in the 1930s and '40s, industries like aircraft production, food processing, and chemical manufacturing -- industries that utilized sophisticated electrical machinery -- succeeded while old-technology industries like agriculture and mining lost profitability and prominence. The same dynamic is at play today. Industries that utilize information as a strategic asset are thriving. Industries that do not are at a serious competitive disadvantage.

The point here is that developing economies face the same challenge today that their counterparts faced 50 years ago: get wired or get out. The regions of the world that "electrified" their urban and rural areas -- like the U.S. and western Europe -- were prepared to compete in the modern economy. Those that didn't fell behind. And the gap separating the developed and developing worlds widened farther than at any other time in history.

Today, the gap separating the so-called "developed" and "developing" countries is defined by access to information. It's the "Telecom Gap." There are roughly 600 million telephones in the world and three-fourths of

them are concentrated in just nine advanced countries. The remainder are scattered unevenly throughout the rest of the world. Tokyo, for example, has more phones than the entire African continent.

The "Telecom Gap" is significant because telecommunications is no longer a luxury. It has become a critical engine of economic growth. Without access to information, developing countries lack the ability to attract foreign investment. Their own industries are ill-equipped to compete in the world economy. And their people are denied what has become a staple in the developed world.

But just because telecommunications isn't a luxury doesn't mean it's suddenly affordable. Or that countries can easily manage the transition from public to private telecommunications industries.

NO LONGER A NATURAL MONOPOLY

The International Telecommunications Union, or ITU, has estimated that most developing countries could probably increase the number of subscribers connected to their networks by 4% to 6% a year. Obviously, the demand for new service dramatically exceeds this rate. And even this meager improvement is accomplished only by reinvesting all of a telco's profits back into the network -- meaning these funds can't be used by the government for other critical needs, such as housing, medicine, and education.

In addition, with only a few exceptions -- Brazil, China, and India, for example -- developing countries don't have indigenous communications manufacturing industries. As a result, in many countries, 60% or more of the cost of a major telecom project has to be paid for in hard currency. And, as we all know, hard currency often has to be diverted to other national obligations.

The financial disparity here is made even more evident when you realize that the developed world invests more than $100 billion a year building and enhancing the global telecom network. For example, AT&T and several partners are spending more than $3 billion just to lay a transoceanic fiber line capable of transmitting five billion bits of information a second.

In most cases, brutal financial realities simply prohibit developing countries from keeping up with these investments. And the result is that the "telecom gap" separating regions of the world threatens to segregate entire nations, economies, and people.

Something has to be done. The developed countries reap no benefits from keeping developing nations out of the telecom club. In fact, it is much more advantageous for the developed world to eliminate the gap. A healthy communications industry and infrastructure in the developing world creates new labor supply. These new jobs strengthen developing economies. And as these economies strengthen, new markets emerge. It is a self-perpetuating cycle of progress.

It's because of this cycle that privatization and deregulation make so much sense. Many countries are concluding, as we in the U.S. did a few years ago, that telecommunications is no longer a natural monopoly. A much broader array of services can be offered at significantly lower rates in a dynamic, competitive environment than in a monopolized environment. Traditional monopolies lack the resources, the expertise, and the desire to keep up with a market characterized by private networks, teleconferencing, faxes, and the like.

Still, telecommunications ministries have to balance the need to enhance their networks with the need to provide universal service to rural as well as urban regions. An unregulated, highly-competitive market will almost always direct resources to urban business centers rather than to "thin routes" in less-populated areas. We've observed this phenomenon in the U.S., where cellular service grew rapidly in metropolitan areas but has been much slower to arrive in rural parts of the country.

Ideally, of course, universal service would be provided evenly throughout a given country. But that ideal is not realistic. For most countries with very limited capital, only one priority at a time can be afforded: either you concentrate on providing plain old telephone service to ever-wider segments of the population or you invest in enhancements to the network to support commercial usage.

Plain old phone service is important but it doesn't pay off like high-tech business service. You can't expect a company like Ford, for example, to build sophisticated plants in regions that can't support its communications needs.

A country like Mexico, however, that offered the necessary communications support, was able to entice Ford to build a stamping and assembly plant in Hermosillo and an engine plant in Chihuahua. Today, Ford is using a mix of telecommunications services made possible only by deregulation: TelMex is providing wireline service, Norcel and Movitel are providing cellular service, and TELECOMM is providing access to the Morelos satellites. This is a perfect example of how a deregulated communications industry can directly affect economic growth.

MAXIMIZING MARKET STRENGTHS

Deregulation alone, however, is not enough. The competitive mix made possible by deregulation has to include a country's established carrier. Unfortunately, most state-owned carriers are burdened by inefficiency, bureaucratic roadblocks, and inadequate capital. In a competitive environment, they are at a serious disadvantage, with the apparatus of the state hanging like an albatross around their necks.

But, when properly managed, these national carriers can have an important edge over their competition. First, start-up companies -- alternate access carriers, value-added resellers, and so forth -- lack the market presence of an established carrier. They have to build their infrastructure and operations from scratch and spend the critical first years of their existence playing catch-up.

Second, even major international players, such as AT&T, Cable & Wireless, and NTT, lack the market knowledge of an indigenous carrier. They may have the capital and the technological expertise to enter the market aggressively, but they face a steep learning curve because they cannot be as familiar with a country's telecom marketplace as that country's own carrier.

The question, then, is how to encourage competition, on one hand, and enable the national carrier to leverage its strengths, on the other. Privatization is an attractive option. It maximizes the strengths of established in-country carriers, alternate access carriers, and foreign investors while encouraging synergies among them. A privatized company like TelMex leverages the carrier's market presence and knowledge with the capital, technology, and management expertise of its competitors.

In addition, privatization can also provide a country with much-needed infusions of cash. Jamaica, for example, sold 20% of its carrier to Cable & Wireless for $55 million. Argentina sold a portion of EnTel to France Telecom for $1.5 billion and, of course, 20% of TelMex was sold to a private consortium for nearly $1.8 billion.

Of course, there are those who oppose the surrender to foreign interests of national sovereignty over telecommunications. But many believe that concern is largely unwarranted.

Look at TelMex, as an example. Today, Mexico has about five lines for every 100 people, compared with the worldwide average of ten lines for every 100 people. And more than 70 percent of Mexico's lines are for residential use, which really isn't contributing as greatly to economic growth.

Since Grupo Carso acquired its controlling interest in TelMex, it has introduced a new network of high-tech services to meet the needs of Mexico's business community. With a new fiber optic network that stretches for nearly 14,000 kilometers, TelMex will be able to increase cross-border communications capacity five-fold, an achievement that will help attract more companies like Ford. Approximately 400 Mexican businesses have already signed up for these new services and demand continues to escalate. One TelMex official compared it to selling water in the desert.

Privatization is a necessary complement to deregulation. Together, these options become a powerful catalyst for growth. Mexico has demonstrated that, when managed properly, a privately-run national carrier, competing with a diverse field of other communications providers, can be the key to developing a modern telecom industry -- and, consequently, a healthy, growing national economy.

THE EVOLVING ROLE OF CELLULAR

The greatest benefit of privatization and deregulation is that it enables sectors of the industry -- such as cellular -- to become an increasingly important part of the picture.

A truly world-class communications industry is characterized by strong players whose growth comes as a complement to -- rather than at the expense of -- the other sectors of the industry. Cellular is certainly a good example of this.

Cellular service providers have two distinct roles. The first is to provide a reliable alternative to the often-unreliable wireline network. Businesses can't afford to wait months and even years to establish phone service. They can't compete when their call completion rates are 50 and 60 percent. They need high-quality voice and data transmission capabilities. And they need it today.

The cellular industry can provide a critical service by meeting these demands. Throughout Mexico, companies like Cedetel and Portatel are providing their customers with the vital communications links they need today. But, it's important to remember that this role does not have to be -- and probably shouldn't be -- the long-term vision of your industry.

The wireline network here is improving. The owners of TelMex have pledged to upgrade the network and expand service significantly over the next few years. If all goes well, Mexico could have a world-class wireline network by the end of the decade.

If it is to have a world-class communications infrastructure, however, it needs more than just reliable wireline telephony. It needs the broad mix of services that are made possible by a deregulated environment. And for that to happen, alternative carriers -- both wireline and non-wireline -- need to see themselves as value-added complements to the network.

The cycle of progress discussed earlier applies in this instance, as well. A strong wireline infrastructure will support the growth of an equally-strong non-wireline infrastructure. Both sectors become pillars that support and lift the industry as a whole.

The world's leading cellular markets are strong evidence. In the U.S., for example, cellular has never played the role of alternative technology. From day one, the U.S. cellular industry has marketed itself as a complement to wireline telephony. And more than 5 million people in the U.S. are cellular subscribers. That's two percent of the population. In Mexico, two percent equals 1.6 million. That's 1.2 million more than some people believe is the maximum market here.

Unbelievable. If Mexico's communications industry as a whole is encouraged to grow, you can realize cellular growth rates that are probably beyond your wildest projections right now. Grow your industry and your markets will follow.

You'll benefit. Your customers will benefit. And, as the bridge across the Telecom Gap is built, the rest of the world will benefit.

ELECTRONIC BYWAYS: CREATING TELECOMMUNICATIONS INCENTIVES FOR ECONOMIC DEVELOPMENT

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ABSTRACT

This paper examines various approaches to creating incentives for investing in and utilizing telecommunications for economic development. These approaches include incentive regulation, changes in rate structures, introduction of competition in services, and interdisciplinary task forces to set goals and priorities. Lessons from the U.S. experience are highlighted that could be applied in other countries seeking to to enhance the role that telecommunications can play in their economic development.[1]

1. Introduction

Deregulation of telecommunications in the United States has been embraced at the federal level, but is also being widely adopted at the state level. Approximately half of the states now have some form of incentive regulation, as opposed to the traditional form of rate-of-return regulation.

Many of these plans are adopted in the name of economic development, with the rationale that states need state-of-the-art infrastructure to be competitive. Yet more than investment in facilities may be needed to ensure that telecommunications contributes to economic development. For example, investment in other infrastructure and affordable pricing of telecommunications capacity for education and social services may also be important. In addition, telecommunications investment is likely to pay off when combined with other factors such as a good transportation system, an educated and reliable workforce, and high quality education and community services.

1. More information on state plans and policies addressed in this paper can be found in Parker, Edwin B. and Heather E. Hudson, Electronic Byways: State Telecommunications Policies for Rural Development, Boulder, CO: Westview, 1992.

2. Regulatory Policies

State regulators may introduce new policies designed to replace rate-of-return regulation with flexibility in rate setting in return for commitments from carriers to upgrade rural facilities and/or imp ve rural services. Special deregulatory policies ma also be introduced for small telephone companies.

Incentive-Based Deregulation

Several states have introduced changes in regulation that allow the carriers considerable pricing flexibility in return for meeting certain conditions. Some states have adopted price caps, which replace rate-of-return regulation with caps on pricing tied to the rate of inflation. Typically, the carrier has considerable pricing flexibility within a range, and must share profits above a certain threshold with its customers. New York was the first state to introduce incentive regulation, in 1986. The California Public Utilities Commission (CPUC) has approved an incentive regulation structure for Pacific Bell and GTE California that will peg prices of the carriers' monopoly services to a productivity-based inflation index. Nebraska is acknowledged as the state that has gone the farthest in deregulating intrastate telecommunications.

Some states have tied deregulation of the carriers to incentives to upgrade infrastructure:

Michigan: The Public Service Commission (PSC) has implemented an incentive regulation plan requiring the BOC to invest a portion of any earnings above 13.5 percent return on equity in network improvement projects not covered by the company's normal $520 million annual construction budget. The balance of the excess profit is split between the company and ratepayers. Michigan Bell has forwarded to the commission a list of enhancements totaling $55 million. It is proposing to spend $29 million to install digital switches on Michigan's rural upper peninsula, $12 million on fiber optic deployment, and the remaining $14 million to upgrade residents from multi line to single line service.

Tennessee: The Tennessee Public Services Commission (PSC) has adopted a master plan that ties regulatory reform to technology deployment. The plan provides earnings sharing and pricing flexibility for local telephone companies provided the companies commit to meeting the 10-year plan which includes deployment of SS7 and eventually ISDN, fiber trunks and switched broadband services.

Texas: As part of a settlement in a rate case before the Texas PUC, Southwestern Bell will replace all of its electromechanical switches in Texas with digital switches over a four year period.

"Social contract"

In this model, regulators, telephone companies, and representatives of users including businesses, social services, and residents agree on policies designed to upgrade services, maintain affordable access, and provide flexibility to the telecommunications carriers.

Vermont: In December 1988, the Vermont Public Service Board approved a five-year agreement with New England Telephone that substantially altered the regulatory framework in Vermont. The Vermont Telecommunications Agreement (VTA) is not total deregulation nor a rate case settlement, but an attempt to modify the regulatory approach to respond to both cost and competitive pressures. A social contract model was adopted, requiring the building of consensus among the state government agencies, consumer representatives, the carrier, and other interested parties. The goal of the social contract was to stabilize rates for basic exchange service and set minimum service quality and modernization criteria for consumers, in exchange for relief from rate of return regulation and greater marketing flexibility for the local exchange carrier.

Deregulatory Policies affecting Small Telephone Companies:

Some states have adopted deregulatory policies not only for major carriers but also affecting small telephone companies. For example, Indiana has deregulated telephone cooperatives. Idaho is considering deregulating small stock telephone companies.

3. Rate Structures Designed to Reduce Rural Disparities

Several approaches have been adopted to reduce the disparities in cost for access to telecommunications and use of telecommunications services in rural areas.

Subsidies for Installation:

Link-Up America: This a federal program designed to preserve and promote telephone subscribership among low income households. Funds are provided to offset 50 percent of the tariff charges for connecting a subscriber to the telephone network. This program is available in urban as well as rural areas, but may be particularly important to rural residents who must travel long distances to get help or exchange information if they lack a telephone.

Several states have programs to subsidize installation in high cost rural areas. For example, in Wyoming, first time telephone service is provided for an installation fee of $375 if costs are under $10,000; the customer pays half the costs in excess of $10,000.

Subsidies for Low Income Subscribers:

Lifeline Service: The FCC has authorized a lifeline service fund, to be matched by state regulators, to help make telephone service affordable to low income subscribers. Most states offer special monthly rates for basic telephone service to customers who meet established low income criteria. Some states such as Arizona, Idaho, and New Mexico are making particular efforts to publicize these programs in rural areas in order to increase participation by the rural poor.

Extended Area Service (EAS):

In many rural regions, callers must pay long distance charges to reach businesses and government agencies that would be accessible with a local call in the city. Several states have implemented policies that enable rural residents to call an extended area for a flat rate, as a means of reducing disparities between rural and urban subscribers.

Colorado: The commission is implementing a plan to create the largest calling areas in the U.S. Costs will be shared by all Colorado residents through slight increases in monthly rates.

Georgia: The state has mandated a county seat calling plan whereby all residents can make free calls to government agencies in the county; it is now introducing county-wide EAS.

Louisiana: The commission has implemented a Local Optional Service (LOS) Plan that caps rates on toll calls within 22 miles of a county/parish calling area. The plan came about through rate case proceedings in which the commission ordered a rate reduction of $36 million, half to be achieved through a reduction in access charges and half through the LOS plan.

Washington: The Washington Utilities and Transportation Commission (WUTC) adopted rules to identify and expand local calling areas where customers must rely excessively on toll service to meet basic calling needs. Telephone companies must identify exchanges in which the average customer can complete less than 80 percent of intraLATA calls toll free. For exchanges that fall below the 80 percent threshold, telephone companies must evaluate possible EAS routes, and propose EAS additions and rates to the Commission. Increased costs that result from expanding local calling areas will be recovered first from customers who directly benefit from increased calling areas. If additional funds are needed, the last source will be increased local rates.

West Virginia: Local calling areas are being established within a 22 mile radius of home exchanges.

4. Economic Incentives: Aggregating Demand

Rural areas often lack economies of scale that would make provision of new services attractive, such as equal access to alternate long distance carriers. With the approval of regulators, small companies may aggregate their demand through pooling traffic to provide a viable market for new services.

Iowa Network Services (INS): INS is a consortium of small independent telephone companies established to concentrate traffic in order to enhance offerings of equal access. Through INS' Des Moines access tandem, long distance carriers have a single point of access for some 150,000 subscriber lines of the INS' member telephone companies. This centralized switch provides inter and intra LATA equal access to 128 rural telephone companies. Iowa is the first state to implement 1+ presubscription and balloting for intra-LATA long distance services.

Kansas: Kansas Independent Network, Inc. (KINI) was formed by 29 independent telephone companies and cooperatives. Kini was established to enhance the independent telephone companies' ability to win cellular lotteries, and is building rural cellular systems in nine areas. It is considering carrying long distance traffic and offering equal access to distance carriers to its customers.

Minnesota: Ninety independent telephone companies have joined together to create Minnesota Equal Access Network Services (MEANS). Using digital technology and optical fiber, MEANS intends to offer centralized equal access and other competitive services currently unavailable in rural Minnesota.

South Dakota: South Dakota Network (SDN) has selected Sioux Falls as a central point from which to offer IXCs cheaper rates to reach rural exchanges than the cost of doing it themselves.

5. Pricing of Services

From the users' point of view, access to technology involves not only availability of equipment but ability to afford to use it. From the carriers' point of view, providing access to educators is not cost free. They must determine how much to charge for use of their facilities. If they decide to offer the services at reduced prices or for free, they must justify this decision, keeping in mind regulations in their state as well as their shareholders. For example, to provide access to unutilized capacity such as "dark fiber," the problem for the phone company is to allocate costs to reflect the fact that these users are benefiting from otherwise unutilized capacity.

Several approaches may be used for pricing these services:

Existing tariffs: Carriers may use existing tariffs, which typically include reduced rates for high volume or off-peak use, and may provide discounts for government users.

Free access: Carriers may decide to provide access to their facilities without charge. Often, this approach is used for a trial or pilot project of fixed duration. At the end of the period, the user must pay to continue to use the capacity.

Reduced prices: To demonstrate their commitment to the community or region, and/or to showcase their technology, carriers may agree to offer educators access to their facilities at reduced rates. Two models appear to be used at present:

- **waiver:** The state's regulatory commission approves a waiver of the existing tariff for educational applications, based on the benefits to the community or state that would otherwise not be obtained. The waiver is generally approved on a case-by-case basis, and may apply only to some carriers or for a limited period.

- **special tariff:** A special tariff may be approved for educational applications. For example, in Maine, the carriers provide access to educators at cost, in an agreement negotiated between the state and the telephone company (Silkman, 1991). In Kansas, the Kansas Corporation Commission (KCC) created a special class of "Economic Development Rates" based on incremental rather than fully allocated cost accounting. These rates are determined on a case-by-case basis, and are designed to recognize the unique circumstances and economic development potential of a particular project or service (Davidson et al., 1990). This rate has been applied to an educational interactive video project in

Kansas involving three telephone companies.

5. Task Forces and Studies as Catalysts for Change

As the role of telecommunications in economic development has become a more visible issue, several states have established task forces to help reach a statewide consensus to revamp state telecommunications policy. The task forces usually bring together a range of participants who share an interest in either telecommunications or development -- telecommunications policy makers, government users, educators, business and other users, and the telecommunications industry.

Alabama: The Information Age Task Force was set up to explore current and future benefits of the intelligent network, issues raised by its deployment, and impacts on all Alabamians, urban and rural. The Task Force is composed of 17 individuals representing small business, the elderly, the disabled, agriculture, education, health care, social services, small municipalities and state government.

California: The Intelligent Network Task Force, sponsored by Pacific Bell, brought together individuals representing California's diverse ethnic and public service constituencies. The group prepared a report explaining how new telecommunications technologies and services could benefit Californians, and recommending widespread access to new services (Intelligent Network Task Force, 1987).

Michigan: A Governor's Telecommunications Task Force including representatives of the Public Service Commission and state departments of commerce, education, labor and management and budget produced a report outlining a strategy for Michigan's future through telecommunications. The task force's chief recommendation was to develop an integrated statewide high capacity switched network (Governor's Telecommunications Task Force, 1990). The task force also commissioned a "Use Assessment of Michigan's Telecommunications Systems" (EDS, 1990).

Minnesota: A study by the Citizen's League looked into ways Minnesota can use new technologies to create opportunities for business and the public. The goals of the Citizen's League are to use Information Age technologies to provide improved public education and health, better government services, economic growth, political awareness, efficiency and productivity and reduce the need for transportation (Citizens League, 1989).

New Jersey: The New Jersey Board of Public Utilities (NJBPU) initiated a study of telecommunications infrastructure funded by the state's three local exchange carriers. The study examined the economic impact of rewiring the state with optical fiber. The report concluded that an advanced telecommunications infrastructure is essential for New Jersey to create the number of new jobs desired for the state (Deloitte and Touche, 1991).

North Carolina: The state has established a task force with forty representatives from the governor's office, education, business, and the telecommunications industry to determine how the state could use telecommunications to attract new businesses, enhance productivity, and upgrade education levels.

Oregon: A task force appointed by the governor included representatives from schools and higher education, local government, large and small users, a telecommunications consultant, and the Oregon PUC. The task force report urged state leaders to develop integrated telecommunications and information technology policies (Task Force on Telecommunications, 1991).

Tennessee: The Information Systems Council is composed of several heads of state government agencies (finance and administration, general services, treasury), a commissioner of the Public Services Commission, 6 legislators and 2 private sector representatives. This council is examining options for investing telecommunications and information technologies to help to diversify the state's economy.

Washington: A Telecommunications Task Force with members drawn from GTE Northwest, US West, and Global Telematics examined future telecommunications services and potential benefits for the state of Washington, with input from consumers, academics, and government.

6. Lessons from the U.S. Experience

While the specifics of the structure and regulation of the telecommunications industry in the U.S. differ from conditions in other countries, there are several lessons from the U.S. experience that could be relevant to other countries concerned with upgrading infrastructure or extending services in support of economic development.

User Participation

User participation is critical if appropriate new technologies and services are to be introduced and rates are to be kept affordable. The involvement of users with regulators and telecommunications industry representatives has been an important component of the planning process in many states. It is still too early to assess the impact of the task forces described above. Yet the process seems valuable, particularly when it involves broad-based participation from government, carriers, and users, both business and residential. To be effective in bringing about change, they should formulate clear goals and plans for reaching the goals. Also, they should have high level support in state government.

User involvement in the regulatory and legislative process has also been important in changing rate structures such as EAS and introducing special rates or discounts for educational uses.

Integrated Planning

Among the recommendations of the task forces were several that could help governments better integrate telecommunications planning with development goals:

- Coordinate government policy making in telecommunications: Michigan proposed establishing a Cabinet Council on Information Technology to coordinate state government efforts in telecommunications and information technologies;

- Facilitate input from users in the policy process. Michigan proposed setting up a State Telecommunications Users Group to provide a means to focus user input to telecommunications management, simplify user needs analysis, assist in standards selection and analysis, and promote shared services and applications;

- Measure progress: Oregon recommended adopting a set of performance measures for the state government's networks and the public telecommunications infrastructure;

- Coordinate planning for voice and data: Oregon proposed eliminating distinctions between telephone (voice) and information technology (data communications) in planning and management of state government networks;

- Try out new services and applications that support state development goals. Hawaii carried out a pilot project on telework to test the viability of reducing travel time and congestion by enabling people to work nearer home using telecommunications; and

- Upgrade telecommunications infrastructure: Reports from several states, including California, Michigan, and New Jersey recommended accelerated deployment of a reasonably priced high capacity network that would benefit business, education, and health care delivery.

The Importance of Incentives

Both regulators and the industry realize that there are many flaws in the "stick" approach of rate-of-return regulation. It is still too early to judge the effectiveness of the "carrot" approaches of incentive deregulation and increased competition. However, other countries may also want to consider strategies that create incentives for investment in appropriate infrastructure.

There are also several models that can be used to introduce incentives through competition. Developing countries are generally reluctant to introduce public network competition because they believe that there are significant economies of scale, and therefore duplication would be wasteful. However, most agree that competition can be successfully introduced in customer premises equipment (CPE) and value added networks or services (VANs).

Yet lack of capacity is a serious problem in many developing countries, and cannot be solved simply by selling telephones and other equipment on the open market. Several strategies may be used to provide capacity where direct competition is considered unacceptable:

- **Resale:** Third parties may be permitted to lease capacity in bulk and resell it in units of bandwidth and/or time appropriate for business customers and other major users. This approach may be suitable where some excess network capacity exists (e.g. between major cities or on domestic or regional satellites).

- **New Services: Franchise or Competition:** The introduction of a new service may be accelerated by issuing licenses for franchises. This approach has been used for cellular radio in several countries.Satellite services such as data communications may also be offered through one or more private licensed carriers. Yet there are dangers of distortion if policy makers do not carefully frame incentives. In Malaysia the price of installing a cellular radio is 1.5 times the national per capita GNP, thus excluding rural communities which were also supposed to benefit from the service (Wellenius et al., 1989). Policies may be framed to generate funds for other priorities. For example, carriers may charge license fees and/or operate base stations or uplinks for the private networks. They might also require that a percentage of the revenues of these services be allocated to implement other services, such as low cost fixed cellular outlets and thin route telephony via satellite.

Local companies: Although in most countries there is a single carrier that provides both local and long distance services, it may make sense to delineate territories that can be served by local entities. In the U.S., the model of rural cooperatives fostered through the Rural Electrification Administration (REA) has been used to bring telephone service to areas ignored by the large carriers. Local enterprises are likely to be more responsive to local needs, whether they be urban or rural. Cooperatives have been introduced in Hungary. Another example of this approach in urban areas is India's Metropolitan Telephone Corporation established to serve Bombay and Delhi.

- **Franchises for Unserved Areas:** Another approach to serving presently unserved areas is to open them up to private franchises. Large carriers may determine that

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some rural areas are too unprofitable to serve in the near term. However, this conclusion may be based on assumptions about the cost of technologies and implementation that could be inappropriate. A more innovative carrier willing to use more appropriate technology such as rural radio systems or small earth stations and to cut costs by hiring local people rather than bringing in outside staff, may be able to run the system at a profit. In Alaska small telephone companies operate local service in villages where earth stations were installed by Alascom, the statewide long distance carrier. Some U.S. states are considering competitive franchising of territory that the large carriers claim is prohibitively expensive to serve (Parker and Hudson, 1992).

The Fallacy of Deregulation

The changing telecommunications environment is often referred to as "deregulation." In fact, virtually everywhere but the U.S. and Canada, the result of changing the telecommunications structure has been the need to introduce regulation where none existed.

When an autonomous structure is established, there becomes a need for oversight. This is particularly true in a monopoly environment, to ensure that the single provider does not abuse monopoly power in setting rates or discriminating between customers. As Goldschmidt points out, liberalization of itself cannot assure competition absent structural and behavioral restraints on former, or "transitional" monopolists (Goldschmidt, 1991). However, even a competitive environment is likely to require some oversight to ensure that service providers are competing fairly, and that their collective activity is serving the national interest.

The functions that a regulator will need to perform or at least supervise include:

Pricing: Where competition exists, the marketplace may serve as a means of ensuring that prices are reasonable. However, for monopoly services, or where demand far exceeds capacity, regulatory intervention may be necessary.

Explicit Subsidies: Internal cross-subsidies are often used to provide affordable services in less profitable areas. With the introduction of competition, it is important to make such subsidies explicit where they remain necessary, in order that a dominant carrier cannot use them to engage in predatory pricing.

Quality of Service: With deregulation comes the potential for degradation of service in less profitable areas, as carriers strive to expand and upgrade the most profitable services. Concern about the deterioration of rural services has been expressed at the state level in the U.S. as well as by consumers in Canada, the U.K. and Australia. It may also be possible to tie service quality standards to other incentives such as pricing flexibility.

Criteria for Access by Multiple Providers: Where service competition is allowed, oversight will be required to ensure that all have equal access to the network, and that the provider of facilities does not enjoy an unfair advantage if it also offers services.

Standards: Uniform standards are required to ensure that equipment is compatible and of acceptable quality. An impartial standards agency will ensure that a dominant carrier or supplier does not introduce standards that unreasonably discriminate against other vendors.

8. Conclusion

The goal of using telecommunications to contribute to development requires an active government policy to ensure that telecommunications plans and services are designed to meet national goals. It also requires flexibility and innovation in services, equipment and pricing to respond to user needs. The states in the U.S. are now undertaking a variety of innovative approaches to regulation, pricing, and planning telecommunications services. This may be considered an experimental phase, since these changes are still too recent for definitive assessment. However, many of the strategies appear promising as means to foster investment in telecommunications and utilization of telecommunications services that will support socio-economic development. The most important challenge for the U.S. and for other countries will be to plan and manage telecommunications not only as a source of revenue but as a strategic resource for development.

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The Impact of Advanced Telecommunications on Business Development and Job Distribution

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1. ABSTRACT

Some advanced telecommunication services, which can improve business efficiency and lead to the creation of new jobs, are reviewed. Industry sectors sectors which will benefit from those services are examined. This is followed by a look at the status of implementation of new services across many Asia/Pacific countries today and the impact on jobs. Finally, we discuss an option for actual implementation which can both provide advanced services and speed implementation of the basic telecommunications network.

2. INTRODUCTION

New telecommunication services and technology are changing the world economy as business becomes increasingly information intensive. The extent to which telecommunications today can impact the distribution of jobs and work is not widely appreciated. This is particularly important to the developing countries of the Asia/Pacific region.

Asia/Pacific countries generally place a strong emphasis on technology transfer to their countries. A major reason for this has been creation of manufacturing jobs. But this is not the only alternative for job creation. In fact, it is critical to developing countries to take advantage of the many new job opportunities in the information sector. The potential for job creation in the information sector and many other sectors is larger than than in the manufacturing sector. And most of these jobs do not require the capital investment that is generally required for manufacturing facilities.

The creation of jobs in many industry sectors in developing countries can be greatly accelerated through the use of telecommunications. Advanced business telecommunications capabilities, which will allow jobs to be created in the services sector, are critical to the economies of all countries.

Advanced telecommunications is already creating jobs in both developed and developing countries today. For example, one company, based in the USA, is making extensive use of software developed for that company in India. Sophisticated satellite communications transport the daily production of software engineers between India and the USA.

Businesses in the developed world can take advantage of generally lower labor rates in the developing world. Developing countries can provide more challenging jobs within their boundaries, as advanced telecommunications erases the problem of distance for people working together in widely dispersed geographical locations.

3. ADVANCED TELECOMMUNICATION SERVICES

3.1 Some Advanced Telecommunication Services Which Create Jobs

In this section we will look at some advanced telecommunication services which go beyond simple transport of information.

Global Automatic Call Distribution

A common requirement in many industries is to make up-to-date customer records available to an agent handling a phone call. For example, a customer may call an insurance company to make a change in coverage.

Typically, such calls are routed to an Automatic Call Distribution (ACD) center. ACD centers are used because they improve efficiencies in handling incoming calls. The most recent advances in ACD allow use of Calling Line Identification to identify the probable customer, from a data base of customer telephone numbers. The records for that customer are then automatically retrieved from a data base of customer records, and delivered to the answering agent's data terminal at the same time that the voice call is routed to that agent.

The process of obtaining the customer's records, based on calling line identification, and delivering them automatically to the agent handling the call saves valuable time, making the agent more efficient. It also makes the agent more responsive to the customer, because the agent does not have to engage in a long dialogue to determine the customer's identity, and then locate the customer's records.

Automatic Call Distribution (ACD) centers could be globally distributed. Some multinational companies, such as airlines, are considering offering twenty four hour service, making use of reservation centers on different continents. For

example, when the end of the business day is reached on one continent, calls could be routed automatically to a reservation center on another continent.

Such an approach will make it possible for companies to put some of their jobs in developing countries, where agents could handle incoming calls for a large variety of applications. To verify the economics, we did an analysis of the breakeven point for placing an ACD center in a developing country in Asia, and routing calls to the center from the USA. The tradeoff was done assuming a DS-1 circuit could be leased, over which all calls would be routed.

At current trans-Pacific DS-1 tariffs, and at current salary levels, an ACD center serving customers in the USA with approximately 40 agents would cost the same to operate in a developing country in Asia as it would in the USA. This is considerably smaller than the size of a many ACD Centers in operation in the USA today. A larger center in Asia would cost even less to operate.

As many more circuits come into operation in trans-Pacific routes through the new fiber optic cables being laid, tariffs will go down. As a result, the cost of operating an Asian ACD Center in a trans Pacific application will become even less. This will make it even more attractive for companies in the USA, Japan and Australia to place ACD centers in developing countries in Asia. The only thing a developing country need do is to provide the capability for private ACD centers to be connected to their public network or to provide this capability as a business service in their public network. Public network based ACD centers are a reality today in North America.

Enhanced Operator Services

Global Automatic Call Distribution is one of many examples of the way in which advanced business telecommunications services could allow a global distribution of jobs. Another example is in the area of operator assistance.

The technology available today makes it possible to greatly expand the concept of an "operator". The "operator" should be viewed as an expert consultant, who could offer many kinds of "consulting" services between two or more persons engaged in a telephone conversation. For example, the "operator as a translator" is a service which has been introduced in the USA.

Language translation is only one of many "expert" operator services which could be offered. Advanced telecommunications allows expert "consultants" to be located in developing countries just as easily as in developed countries. Such jobs will represent an important trend in the emerging information age.

3.2 Some Advanced Telecommunication Services Which Promote Business Efficiency

Audio Conferencing

Communications services which enable people in business to make more efficient use of their time are particularly important. To give an example, the one to two hour audio teleconference is becoming one of the most common kinds of meetings in many companies in North America. Documents required are distributed to all participants by facsimile and/or electronic mail shortly before the meeting (and sometimes during the meeting).

The payoff in business efficiency has made this a way of life for many businesses which operate in multiple locations. In terms of direct cost for the long distance telephone calls, these meetings will usually cost US$100-300 - usually less than the travel within North America would cost for only one of the participants. The equipment required is also relatively inexpensive. Some companies own conference bridges which can accommodate up to 96 people simultaneously in multiple conferences ranging from three to 96 persons. But audio conference bridges in the public networks are making this a service which is affordable even by smaller companies which cannot afford to own their teleconference bridge.

Audio teleconferencing enables people to work together, regardless of where they are located. This allows organizations to be structured more efficiently. People don't have to be moved to a central location. And advanced telecommunications services are less costly to implement, than building airports.

This has important implications for developing countries. If a developing country has advanced telecommunications, it becomes possible for multinational business to locate jobs in those developing countries. The kinds of jobs involved are those which do not depend on building expensive factories. And developing countries have many intelligent people with the skills required or who can acquire the skills.

Other Services Which Promote Business Efficiency

Some other examples of business telecommunication services which improve business efficiency include voice and text messaging, transaction validation and authorization, fast call set up, calling name display, and corporate dialing plans.

The business efficiencies available from text messaging (e-mail) and voice messaging have been discussed extensively in the literature and need not be repeated here. The benefits of transaction validation and authorization are so important that they have already been widely implemented and accepted, for example through networks of Automatic Teller Machines.

Fast call set up overcomes the long time required to set up calls. Even international calls are set up in less than one second. To human perception, the phone on the other end of the call begins ringing as soon as the last digit of the call is entered. This kind of speed results in efficiencies for everyone - for the telephone company, for the business making the call, and for the individuals involved. Slow call set up, coupled with a poor call completion rate creates serious inefficiencies in business.

Calling name display/calling number display is widely deployed in some private networks today. The service allows screening of incoming calls, to decide whether to answer or to let a secretary or a voice messaging system answer, providing greater efficiencies in the business day.

Corporate dialing plans are another important mechanism for facilitating information collection and dissemination. Communications are made more efficient by eliminating the need to look up city codes and country codes

As the world economy shifts to the information age, it is imperative that developing countries of Asia/Pacific implement advanced business telecommunication services now, so they can compete in the global economy.

4. NEW SERVICES AND JOB CREATION

4.1 Industry Sectors Which Will Benefit from Advanced Telecommunications Services

Advanced telecommunication facilities are a prerequisite for business promotion which has an immediate impact on job creation - including self employment. The role of telecommunications in providing the essential infrastructure for economic growth is now well understood, but its important contribution in developing various other sectors has mostly remained unfathomed and under recognized.

Telecommunication provides a vast reservoir of undertapped potential in improving the productivity of many job generating sectors like transport, banking, shipping, warehousing, trade and commerce, tourism, agriculture and dairy products, exploitation of natural resources and several others.

In all these activities, telecommunication services create more business potential in two ways - first by fueling the growth of the businesses which they serve and then by creating more opportunities through the growth of the telecommunication sector itself. Both these factors contribute to a multiplier effect. In many countries, the telecommunication sector continues to be one of the largest employers, in spite of the fact that it has always been a 'state of the art,' hi-tech sector.

Telecommunication also opens new avenues for job creation and job distribution in the intellectual property domain. With the introduction of many new services and facilities, there will be several job transfers and job upgrades as well. However, all these activities need efforts for their proper coordination , and, of course, an acumen for their fruitful utilization.

Let us take the example of a rather new field - Distance Education. The percentage of literacy in some countries of the Asia-Pacific region is even less than 20%. Telecommunication can provide a tremendous boost to the program of Distance Learning and will create several jobs in the telecommunication and education sectors. This will be in addition to the jobs which the improved skills will bring to the learners.

Development of telecommunications services in both private and government sectors will create jobs in telecommunication training covering not only the actual instruction but also other support activities like art work, documentation, audio-visual aids, video filming, etc.

The tourism sector has immense potential for creating several opporutunities for telecom related personnel in such wide ranging areas as aviation, transport, hotels and other support services like advertising, video filming, etc. Imagine setting up a telecom business center at each important tourist location, each rental car having a mobile telephone and each travel agency using a number of mobile telephones. The marketing of mobile telephones itself will create many jobs.

4.2 Current Status and Expectations

The development of a particular type of service will depend upon the quantum and variety of business applications in a city and in a country. Highly developed networks like those in Australia, Hong Kong, Japan, Republic of Korea, Singapore, etc. provide good opportunities for services like E-mail, EDI, video/audio conferencing, etc. India offers excellent opportunities for growth in software related communications. Malaysia, Indonesia and Thailand are using data networks for business related information. Socio-economic applications of telecommunications are an urgent need in all the developing countries of the Asia-Pacific region.

Appendix 1 gives an idea of the current situation with regard to implementation of advanced telecommunication services in many countries across Asia/Pacific and their likely impact on job potential on a country by country basis.

In addition to the impact within countries on an individuals basis, there is an opportunity for countries to benefit from the telecommunication requirements of large multinational corporations. These corporations need enhanced services, and can pay premium revenues for them. These corporations became accustomed in the 1980s to advanced telecommunications features and services available domestically on private networks and virtual networks. Now they want the same

another part of the revenue goes to pay for the Intelligent Network equipment.

5.3 Details of the Approach

The cost of equipping all switches in a national network to deliver new services has made it impossible for public networks to offer many of the features and services discussed in Section 3. The Intelligent Network approach makes it unnecessary to implement the services on every switch in the network. A key enabling technology is the combination of ISDN and CCITT Number 7 Signalling. Interworking between ISDN and CCITT Number 7 Signaling will eventually make it possible to reach the services at one or a few central locations where the Service Control Points (SCPs) are located from everywhere in the basic network.

ISDN implementations and implementation of CCITT Number 7 Signalling usually take place first in and between the major business centers of a country. This is where the Intelligent Network overlay should be implemented. A beginning is made by identifying appropriate business sectors and connecting their concerned centers. Intelligent call routing and call transfers can take advantage of the time difference in the busy hour traffics of different places and generate more revenue, together with more work - a happy situation in which every player wins.

In some cases, the most appropriate path is for a carrier to implement a bypass of its own network. This may be in the form of an international gateway which also provides enhanced business services, including global networking services. Or it may be a tandem network node which is co-located with a digital international gateway. It may even be a nearby central exchange.

Whether the Intelligent Network Services Switching Point (SSP) function is in the international gateway, in a tandem node adjacent to it, or in a nearby central exchange, a Services Control Point (SCP) will be associated with it. Advanced business services will be provided from the SCP. Depending on the level of signaling available in the existing network, businesses may initially be connected directly to the SSP. The choice of where to locate an SSP: in the international gateway, in a nearby tandem switch, or in a local central exchange may be further complicated by constraints associated with regulation or deregulation.

As discussed above, some of those revenues derived from advanced telecommunication services can be used to upgrade the existing network with ISDN and CCITT Number 7. As the existing network is upgraded, the advanced services can be made available to an increasing number of businesses, accessing the services in the overlay network through the upgraded basic network, using ISDN/CCITT Number 7 signaling. And, as the basic network continues to be upgraded, the conversion of the entire existing network to an all digital, ISDN/CCITT Number 7 base will be speeded up. Traffic requirements and regulatory requirements are some of the many constraints which will dictate the resulting network topology, which can vary substantially from one country to another.

5.4 Strengthening Regional Services

The first phase can be started with the networking of selected metropolitan areas, and in subsequent phases private networks can be interlinked. However, it is essential to strengthen sub regional, inter regional, intra regional and inter services cooperation for successful implementation of the programs.

Some business sectors, which are not key within a single country, will become important when they are considered on a regional basis. In many cases, CCITT Number 7 Signalling and ISDN will be available first in international gateways. These factors make it important to consider implementation of advanced telecommunications services for business sectors which will prove in economically on a regional basis, but not on a domestic basis. This implies some sharing of SCPs by carriers in several countries, which will raise complex policy issues. Nevertheless, it is important to make a start on regional services. "Regional" could mean areas like the ASEAN countries only in some cases, but it could mean all of Asia/Pacific in other cases.

5.5 Positioning for Broadband Services

The digital intelligent network overlay approach provides excellent positioning for implementation of broadband services on digital optical fiber communication paths and through broadband switches. The capabilities of the Service Switching Point (SSP), shown as the Overlay Node in Figure 1, will evolve gracefully to handle the new wideband and broadband services which are beginning to appear. For example, the overlay network is a logical point to implement video teleconference services as an extension to audio teleconference services. As broadband access capabilities are built into the SSPs, a host of other broadband communication services is forecast to emerge during the mid-1990s.

The same industries and metropolitan centers which will benefit first from the narrowband advanced telecommunication services discussed earlier, will be the ones to first use the new wideband and broadband communication services. Digital optical fiber can be extended to these industries first, and their initial connection will be the overlay network. This will provide the fastest mechanism for actually implementing wideband and broadband services. And these industries are the most likely to be able to pay for the broadband services, just as they are the most likely to pay for narrowband services today.

features on a global basis in the 1990s. A few examples of the businesses which are active in global networking today include aerospace, manufacturing, finance and banking, transportation, and tourism.

Many nations have already recognized that providing advanced telecommunications to large multinational businesses will attract those businesses to establish a significant presence in their country. Conversely, these same businesses will not locate major activities in countries which will not support their requirements for advanced communications. As a result, many developing countries are making early provision of enhanced business communication services a matter of high priority in national development policy.

5. AN OPTION FOR IMPLEMENTING ADVANCED SERVICES

5.1 Advanced Services Versus The Basic Network

The goals of telecommunications network development must be to implement a ubiquitous network to meet the basic communication requirements of society, and, **concurrently**, to provide an advanced network to meet the business communications requirements of industry. These goals are viewed as contradictory by some, but are gradually being recognized by others as complementary.

Conventional wisdom says that a developing country must first implement a full nationwide digital network infrastructure. Only after that is accomplished can the kinds of advanced business services discussed above be implemented. Unfortunately, that strategy will leave developing countries in a "catch-up mode," because many do not have the hard currency needed to import the digital equipment, and few can afford to develop the equipment themselves. Meanwhile, business in developing countries will remain less competitive than it's counterparts in the developed world, perpetuating an already difficult situation.

5.2 The Overlay Network Option

Wide scale implementation of an advanced digital network is hampered by financial constraints and even by limitations on how fast equipment may be written off. In many cases, digital equipment (and even some analog) cannot be replaced yet because it still has a significant useful life, from a financial point of view. The solution to the dilemma is to implement a business services network overlay (Fig 1.).

One purpose of a business services digital overlay network is to provide advanced services to improve business efficiency. A second purpose is to generate the hard currency so badly needed for more rapid implementation of the basic digital network.

Improving Business Efficiency

Advanced telecommunication services tailored to the business environment of a country, can be implemented efficiently in an intelligent network overlay to the basic network. The kinds of services discussed above, and many others can be implemented in the overlay, without disturbing the basic network.

Digital Overlay Network Concept

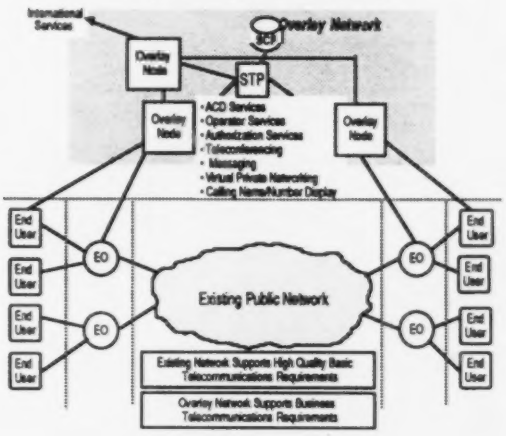

Figure 1

In an intelligent network overlay, services are implemented in a Services Control Point (SCP) (Fig. 1). This is a significant change from implementing services in every switch in the basic network, which is the only option available to most administrations today. An Intelligent Network Service Maintenance System (SMS) (not shown), greatly simplifies Operations, Administration, Maintenance and Provisioning (OAMP) for the advanced services, and reduces costs in all of these areas.

An Intelligent Network Services Creation Environment will make it possible for carriers to implement services specifically tailored to the way business is done in their own regions/countries. This will maximize the benefit of the services to improved business efficiency in each country.

Generating Hard Currency to Improve the Basic Network.

Multinational corporations and major domestic businesses will be willing to pay premium revenues for advanced telecommunications services which improve their efficiency in measurable terms. Typically, the cost of equipment on which enhanced business services are implemented can be amortized within five years, out of business revenues generated from services provided on that equipment. Some revenue from advanced business services can be used to pay for more rapid implementation of the basic digital network while

6. CONCLUSIONS

By examining some specific services, we have seen how advanced telecommunications services improve business efficiency and create new jobs in the economies of the countries which implement the services

Through examination of some specific industry sectors, it is clear that the variety of sectors which will benefit from advanced telecommunication services is much wider than has generally been appreciated

Development of particular services varies widely, but many new services have already been implemented across the Asia/Pacific region. This is already having a positive impact on the quantity and quality of new jobs being created throughout the region.

An intelligent network overlay represents an effective and affordable option for early implementation of advanced telecommunications services. And this option can also speed up implementation of the basic digital network infrastructure needed by every country.

The result will be an environment in which everyone wins - business becomes more efficient , the national network becomes an all digital network which is more reliable and less costly to maintain, and business becomes more responsive to its customers.

Appendix 1 NEW TELECOM SERVICES IN SOME COUNTRIES OF ASIA-PACIFIC REGION AND THEIR LIKELY IMPACT ON JOB POTENTIAL

	Country	New Services	Impacts
1.	Afghanistan	Present emphasis is on developing the basic services. VAS are likely to be introduced subsequently	More jobs are likely to be created in the government sector and in construction industry
2.	Australia	Mobile, Paging and several other services increasing in popularity. Electronic Funds Transfer at Point of Sale (EFTPOS) using Australian Packet Switched Network (AUSTPAC) is being used by several major banks in Australia.	Growth of hi-tech business is likely to create more job avenues including self employment opportunities in future.
3.	Bangladesh	402 Sub-district Hqs. being connected to respective district headquarters. After completion of the work, BTTB intends to extend computer service terminated into rural centers for banking, administration, agriculture and other social service sectors	Creation of jobs in telecom and other concerned sectors. Creation of more jobs in building construction, installation, and computer operation and servicing sectors.
4.	Brunei	Mobile and Paging Services have already been introduced. Telecommunication facilities are being developed rapidly and are finding increasing application in the business sector.	Development of telecommunication and information sectors will create more avenues for employment including self employment.
5.	Peoples Republic of China	The number of users in China's Packet Switching Network (CNPAC) has increased rapidly. About 2/3rd of CNPAC traffic volume is from foreign trade organizations in Beijing (mainly Mailbox and information retrieval services, derived from databases in the USA). High priority will be given for popularization of E-Mail and EDI.	More jobs in research, development and service sectors. Also creates more business and development prospects in other countries.
6.	India	India's software expertise is used in the USA through dedicated satellite links. Voice mail, videotext, fax, paging, PSTN, GPSS, Satellite Based Remote Area Message Network, E Mail specialized data network are already in use. Massive program for development of Rural Communications has been launched. Telephone booths operated by disabled persons are already a big success.	Several new avenues in government, public and private sectors covering research and development, manufacturing, servicing and procurement, software applications, etc., have been created.
7.	Indonesia	New services such as Packet Switching Public Data Network, Fax, Mobile Services, Electronic Mail, Pager, etc. have been introduced. Liberalization of non basic services has already begun. Telecom service and manufacturing sectors are growing rapidly.	New job opportunities with increase in variety and number of services.
8.	Islamic Republic of Iran	Basic services being augmented and new services planned for phased introduction. Increasing telecom applications providing good boost to the business sector.	Developments in telecom and business sector are likely to create more jobs in private sector.
9.	Japan	All kinds of research, manufacturing and service activities. Business growth through about 900 carriers.	Emergence and growth of information industry.

Appendix 1 (Cont'nd)

NEW TELECOM SERVICES IN SOME COUNTRIES OF ASIA-PACIFIC REGION AND THEIR LIKELY IMPACT ON JOB POTENTIAL

Country	New Services	Impacts
10. The Republic of Korea	VANs quite developed. Korea Telecom and DACOM are public common carriers. In addition there are 22 registered private VAN operators. The size of domestic VANs market was US$213 million in 1990, which is likely to grow to US$413 million in 1992.	More job opportunities due to the development of new services and high growth potential of business in the information sector.
11. Lao. PDR	The present priority is on developing basic services.	Increasing use of telecommunications will create more employment in future.
12. Malaysia	Packet switched (MAYPAC) and Circuit Switched (MAYCIS) data networks and Value Added Services like Videotex, Telemail, are growing steadily. Videotex services finding wide application. A joint venture co. with IBM (Malaysia) has been formed which will promote EDI and will also offer other services like E-Mail etc.	More self employment opportunities due to introduction of new kind of business Videotex impacting microcomputing, fishery information, shipping, flight information, on-line share price, real estate properties, drug/poison database, education, classified advertising.
13. Maldives	Many new services have been planned for introduction in a phased manner.	Likely increase in job avenues due to more telecom support to business.
14. Myanmar	There is a heavy demand for basic services. Value Added Services may be introduced at a later stage.	More employment in government sector due to increase in telecom services.
15. Nauru	Increased communication with the neighboring countries opens up new business avenues.	Likely increase in jobs due to increase in business activities.
16. Nepal	About 80% of the telephone lines are digitalized. International as well as domestic traffic has increased sharply. Leased circuits and telefax have already become popular. Introduction of other services also being planned shortly.	More jobs expected in government sector due to more development activities. Improved telecom facilities promoting use of computers in several areas, which will result in more job avenues.
17. Pakistan	Packet Switching Network introduced in 1990. Electronic Message handling services, Bulletin Board services and Data Base services are being planned.	Development of these services is likely to create more jobs in private sector.
18. Philippines	Cellular Mobile, Radio Paging, VSAT and several other services are being provided to the customers.	More jobs expected due to development of these services in the private sector.
19. Singapore	A Variety of New Services are provided. Value Added Services have been liberalized and are growing fast. Hi-tech applications have given a tremendous boost to business.	More employment opportunities in business sector and also more opportunities for self employment due to hi-tech applications in business. Hi-tech exhibition industry itself provides many job opportunities.
20. Sri Lanka	Liberalization and development of telecom service is underway. New services are being introduced in a phased manner.	Employment opportunities in private sector likely to increase through new telecommunications.
21. Thailand	Value Added Services such as Datanet, Videotext, Telebox, Faxcom, Voicemail, Mobile services, Infonet, etc., have grown rapidly.	Higher employment potential due to increased business activities in the private sector. Also due to massive expansion of telecom services, more jobs are expected in the government sector.
22. Vietnam	Data transmission centres in Hanoi and Ho Chi Minh City are serving customers in banks, import/export companies, government departments and news agencies. Other development plans are under various stages of implementation.	Increased job opportunities in private and government sectors.
23. Hong Kong	A variety of Value Added services is being provided to business and government users. Demand for these services goes on increasing.	Development of telecom facilities and the growth of business create more jobs in private sectors.
24. Cook Islands	Ambitious development plans have been prepared proposing the use of small INTELSAT DI-Satellite Earth Station using OTC DAMA Network for both national and international communications. Interconnection of islands will help implementation of development activities and growth of business.	More jobs due to rise in business and development activities.

RURAL TELECOMMUNICATIONS DEVELOPMENT
THE REA CONCEPT

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ABSTRACT

Developing countries continue to face difficulties in providing modern telecommunications services to rural areas because of high costs and low revenues. Incentives for the provider in the form of attractive investment loans and technical assistance could help. The successful U.S. REA telephone loan program is described as one possible solution.

1.0 INTRODUCTION

Few discussions on worldwide telecommunications development fail to mention the relatively slow progress on expanding and improving services to rural areas in many countries. The situation was strikingly illustrated in the 1984 Maitland Report's "Missing Link". Today, the great disparity in access to telephone service is still evident despite significant accomplishments in a number of developing countries during the last decade.

2.0 STATISTICS

While the traditional measurement of "telephones per hundred population" indicates substantial progress in some countries, the statistics often fail to reveal the true picture. The figures are normally averaged for the entire country, but most of the access lines are actually concentrated in the densely populated urban areas.

Let's assume, for example, that a country with an overall service penetration of less than one telephone per hundred persons increases this figure to five through a bold construction program. That would be a significant expansion; however, closer examination might reveal that the major cities exceed ten telephones per hundred, smaller urban areas have two to three per hundred with the rural areas remaining still unserved or with an unchanged fractional penetration level.

3.0 INVESTMENT IN RURAL AREAS

It is reasonable to expect that investment priorities for telecommunications facilities in developing countries will favor urban areas because this is where businesses are concentrated. Because commercial enterprises foster national economic competitiveness and attract foreign capital, their basic needs are first to be met. Most administrations face a difficult task securing sufficient funding just to meet the accelerating demand for service in cities despite the almost assured adequate return on investment. Thus, deferring activities in rural areas can be justified from an economic viewpoint.

The rural areas not only lack the economies of scale achievable in the cities, but they are beset by other adverse factors:

1) High system construction costs in widely scattered communities with comparatively low population densities often located in isolated places.

2) Higher operating expenses resulting from a lack of local skilled maintenance personnel and longer distances from supply centers.

3) Fewer businesses and less affluent inhabitants to generate additional revenues from long distance services.

4.0 PRIVATIZATION

In many countries, telecommunications services are provided by state owned and operated organizations staffed with government employees. Funding for expansion and modernization of facilities is often insufficient. Surplus earnings from operations are frequently diverted to other government functions. Despite their altruistic goals to provide nationwide universal service, few

government systems are able to adequately meet the requirements of their nation's rural areas.

The current trend towards privatization of government telephone systems, with all of its potential advantages, may not help improve rural area service unless incentives are provided for the private investor. Few, if any, businesses with normal profitability goals would conscientiously make substantial capital investments in areas where returns are marginal or, more typically, negative. For these reasons, governments may be concerned that privatization could further inhibit rural area development and universal service.

While the high cost - low revenue scenario alone might be sufficient to discourage many private operators from establishing rural telephone service, the additional problem of securing adequate financing at attractive interest rates could make the undertaking totally unfeasible. Reducing the high cost of installing facilities and increasing revenues in rural areas may be difficult to achieve but there are ways to make the financing of these projects more favorable, thus removing at least one major hardship.

The United States remains as the world's leading proponent of telecommunications privatization. Prior to the breakup of AT&T, thousands of small independent telephone operations were providing service to rural America. They ranged from tiny cooperatives serving small farm communities to medium sized companies with large territories, some of which included villages and towns. Today, the Regional Bell Operating Companies and GTE cover over 90% of the nation but many of the small independents still survive and continue to provide modern telecommunications services. The capability of these systems is equal and sometimes superior to their larger counterparts in some areas.

5.0 THE REA PROGRAM

The achievement of furnishing high quality, universally available and affordable telephone service to rural America is partly the result of a unique financing and technical assistance program established by the U.S. government under the Department of Agriculture. This agency is called the Rural Electrification Administration (REA) which, for over 40 years, has assisted more than 1,000 telephone companies to build, expand and modernize their systems in 46 states and six overseas territories. The borrowers' incentives include capital availability, lower interest rates and less demanding financial qualification requirements for loans as compared to commercial lenders.

REA was initially established as a source of loan funds and technical assistance for the provision of rural electric service. In 1949, its mission was expanded to extend similar benefits to rural telephone system operators. These companies and cooperatives average only about six subscribers per mile of telephone line with a median number of subscribers per borrower of around 2,400.

REA borrowers average more than 1,000 route miles per system with a total of $13 billion invested in facilities to serve their nearly six million subscribers. Although only 4.3% of all telephone subscribers in the U.S. derive telephone services from REA borrowers, they cover nearly 1.3 million square miles or around 37% of the nation's entire land expanse.

In many countries with substantial rural areas, the situation is little different from the U.S. The two factors - high cost and low population density - tend to inhibit effective rural telecommunications development without some type of financial assistance and other incentives for the service providers.

To date, the REA telephone loan program has approved debt financing totaling nearly $10 billion. About $5 billion in principal and interest have been repaid. Borrower loan repayments nearly equal REA cash outlays; therefore, on a cash basis, the program is almost self-sustaining. The incremental subsidy cost to the U.S. government for all telephone loans in fiscal 1990 was under $7 million, while the cost of administering the REA telephone loan program was almost as minimal.

Technical oversight such as installation practices and procedures, testing and evaluation of equipment and contract documents are provided at no cost to REA borrowers. In return, they must adhere to certain technical design standards and construction procedures to assure that REA financed telephone systems will provide high quality and reliable service. Stringent administrative procedures guarantee that REA funds will only be used for approved purposes.

The following provides some details of the REA telephone loan program in the U.S. Other countries may want to consider using this program as a model for developing their own conception of government sponsored incentives for private companies and public service corporations tasked with installing or modernizing rural telephone facilities.

6.0 REA's PHILOSOPHY

REA's philosophy is based on service, rather than the generation of profit. That is, profit is the result of providing service instead of the frequently expressed belief that service is the result of profit. REA's two primary concerns are service to the subscriber and debt service on the loan. While they recognize that a business must make a profit to survive, there is no emphasis on maximizing profit.

REA's service goals are expressed in several of its fundamental policies:

Area Coverage - With minor exceptions, all subscribers within a borrower's service area will be provided telephone service without additional charges for construction regardless of the cost and difficulty of bringing facilities to the subscriber.

Service Rates - All subscribers will pay the same rate for the lowest level of basic telephone service provided, typically one-party.

Favorable Loan Terms - Loans will be long term, up to 35 years with attractive interest rates and no prepayment penalties on most loans.

Construction Standards - Standardized specifications, construction procedures and contractual documents will be used on all REA financed projects.

List of Materials - REA financed projects must use proven equipment and materials that meet the standards for high quality service. REA maintains a list of approved items which have undergone laboratory analysis and field testing.

Engineering and Management Assistance - REA assists the borrowers in developing a qualified and competent staff to handle the engineering, accounting and management functions and encourages the use of approved consultants to augment the staff.

7.0 REA's LOAN PROGRAMS

The REA telephone loan program currently has three methods for financing its borrowers' projects:

Insured loans - Direct loans from REA at 5% interest with a term not exceeding 35 years.

Rural Telephone Bank loans - Variable interest rates on loans up to 35 years.

Guaranteed loans - 100% guarantee by REA to the lender on repayment of principal and interest for loans obtained from commercial financing sources.

The various REA loan programs are continuously monitored by the U.S. government which periodically enacts legislation and rule changes to assure that the objectives of the program are being met.

8.0 GENERAL PROCEDURES

REA's procedures are designed to protect the lender, borrower, contractors and suppliers. They also require consistency to promote fair and honest treatment of all parties.

The REA loan process is divided into two basic steps. The first is the pre-loan process which includes preparing a subscriber forecast, system design plans, loan agreements and supporting documentation for submission to REA. Following approval of the loan, the second step, or post-loan activities, covers implementation and operation of the project.

The following overview covers the major components of an REA loan:

8.1 Loan Agreements

All REA loan agreements must contractually ensure that the objectives of providing service and achieving the purposes of the loan are being met. Certain safeguards are therefore required in the loan agreements:

1) The lender must have the power to enforce the provisions of the loan.

2) If the loan objectives are not being met, the lender has the power to take control of the borrower's operations.

3) Appropriate security measures must be taken to protect the lender's interests.

4) REA Loan funds must be maintained in separate accounts and disbursed only when and to whom REA directs.

8.2 Design Procedures

REA has established system design standards and procedures to ensure that modern, compatible, high quality and reliable service will be provided to subscribers on projects which use its loan funds. All borrowers and their consultants are provided with a comprehensive series of REA technical publications covering the approved design and construction procedures for rural telephone systems. The primary areas addressed are:

1) Switching and transmission standards.

2) Electrical protection requirements.

3) System expendability to meet new service demands.

4) System flexibility to provide new service features.

8.3 Construction Planning

REA has prepared design and construction specifications to assure that equipment manufacturers and contractors tasked with installation and construction will build telephone systems that meet the desired objectives. These cover:

1) Standardized specifications for switching and transmission equipment, cables, hardware, etc.

2) Testing procedures to assure that performance specifications are met.

8.4 Contracts

REA provides standard contract forms to ensure that the borrowers as well as the suppliers and contractors are protected and that the system will be implemented on a timely basis in accordance with specifications. Contracts typically include:

1) Bid bonds.

2) Performance bonds.

3) Insurance requirements.

4) Supplier and contractor payment terms.

5) Warranty provisions.

8.5 Bidding

REA requires strict adherence to standardized bidding procedures to ensure that all qualified bidders are treated equably. Competitive bidding procedures include:

1) Prequalification of bidders.

2) Pre-bid conferences.

3) Bid evaluation for responsiveness to specifications and inclusion of all pertinent documents in the bid package.

8.6 Construction Procedures

To ensure acceptable contractor performance and adherence to specifications, REA requires that all construction and installation work be monitored and inspected. This can be performed either by a qualified independent consulting firm or the borrower's staff if they are qualified and approved by REA to perform the work. Major activities include:

1) Pre-construction conferences with appropriate documentation.

2) Review of materials to be used on the project.

3) Field inspections during construction.

4) Acceptance testing.

5) Documentation of "as built" system.

8.7 Monitoring and Audits

REA monitors the borrower's financial strength and requires fiscal controls to assure its overall viability and capability of repaying the loan. The items reviewed include:

1) Operating reports and year end financial statements.

2) Insurance coverage.

3) Service trouble reports.

4) Compliance with appropriate laws associated with the loan agreement.

5) Annual audits conducted by a CPA firm.

6) Periodic audits of loan fund expenditures by REA field staff.

8.8 Use of Consultants

Many REA borrowers, particularly those without large engineering and construction staffs, use engineering consultants for some or all elements of the loan program. Frequently, these firms are requested to handle everything from preparation of loan request documents to final inspection and acceptance of the system. Consulting firms working with REA financed projects should have the following qualifications:

1) No business affiliation with any equipment manufacturer, supplier or contractor.

2) A qualified staff of professional engineers and technical personnel experienced in all telephone system technologies.

3) Familiarity with REA technical and administrative procedures and access to all REA publications.

4) Availability of experienced field personnel for project coordination, inspection and testing of all installation and construction.

9.0 CONCLUSION

The success of the REA program can be attributed to its basic goal of service. The ultimate beneficiaries of the program are the users who might otherwise be deprived of an essential benefit to health, safety, welfare and quality of life simply because they reside in rural areas. The nation as a whole also profits because rural area development stimulates business activity, creates employment and produces revenues.

While financial incentives alone could be sufficient for encouraging service providers to invest in rural telecommunications facilities, other benefits of the program should not be underestimated. For example, the standards and specifications for design and construction will ensure optimum service quality and efficient use of funds. The management and operational oversight requirements assure overall viability. Accounting and fiscal controls protect the lender. Loan agreements between the borrowers and the lender ensure compliance with the lender's policies and require that the funds be used only for the provision of service.

In the U.S., the REA telephone loan program is administered by the government and the lending agency uses government funds. In other countries, a similar program could be carried out by non-governmental entities such as development banks or private financial institutions. All or parts of the program could be used depending on the overall situation in particular areas. The process could be customized to fit the unique requirements of a particular country and include the key ingredients of capital availability, standardized loan contracts and agreements, technical standards, policies, procedures, program monitoring and auditing.

REA's telephone loan program has proven itself in the U.S. for many decades. Rural America's telecommunications services are unsurpassed in the world, but the program is still needed and utilized today. New telecommunications services, essential for rural economic development, require infrastructure improvement through deployment of new technology. Recognizing this, industry and government experts alike believe there will always be a need for REA's capital and technical assistance.

OPEN NETWORK ARCHITECTURE FOR CELLULAR SYSTEMS

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ABSTRACT

The first generation of cellular systems was introduced using proprietary architectures--different from each manufacturer. Second generation cellular architectures are now being introduced coincident with adopting digital techniques at the air interface.

Two digital specifications, GSM and DECT 1800 specify an entire open systems architecture which, for the first time, permits mixing vendor infrastructure components to achieve a complete cellular system providing operators a new level of vendor independence and competitive prices. Motorola has embraced this open system's revolution and is extending it to support other worldwide digital standards. Cost effective implementation of PCN/PCS will require further evolution of these standards to permit sharing of existing PSTN infrastructure to reduce PCN/PCS infrastructure cost and implementation intervals. Experimental trials of several variations of these concepts are expected to take place in 1992.

INTRODUCTION

For landline telephony, the era of proprietary, single vendor, infrastructure systems, typically by country or region, came to a close in the 80's facilitated by the rapid adoption of SS7 technology and worldwide deregulation. Indeed, in many countries, it is now typical that local loop operators source two or three switch and Intelligent Network (IN) vendors and that multiple long distance operators interface with the local carriers utilizing a wide diversity of vendors. It is also useful to recall, that the equivalent of the Air Interface specification for the local loop, the Tip/Ring interface, was for the most part, closed to terminal competition in landline telephony until regulatory decisions like Carter phone and its international equivalents were issued during the 70's.

Initial cellular systems designed in the early 80's adopted the prevailing open standards behavior of landline at that time. That is, only the air interface or terminal specification was standardized and "open". All initial infrastructure designs were completely different and totally proprietary to each vendor. This forced operators to select a single vendor for their cellular infrastructure reducing the operator's long term leverage on prices and, effectively, forcing the operator to make a long term technology bet, in a dynamic, cellular technology, which is still in its infancy.

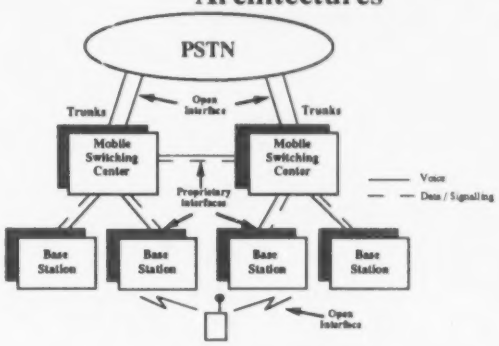
Significant progress has been made in some markets in "opening up" the infrastructure systems design as second generation, digital cellular has been specified. GSM is the best example which now is in early deployment and is already beginning to provide operators with an entirely new level of vendor independence and price competitiveness. Motorola is extending the concepts pioneered in GSM to propagate open interfaces across worldwide cellular and PCN standards.

INITIAL CELLULAR SYSTEMS

Figure 1 illustrates the architecture of the initial cellular infrastructure systems.

Figure 1

Initial Cellular Infrastructure Architectures



Each vendor's offer was proprietary, providing a complete infrastructure system from cells to switching. The key interfaces, that is between the base station and the switch and the switch to switch roaming protocols were totally proprietary from each vendor. The only "open" interface was the air interface specification between the subscriber unit and the base station and the trunk interface between the Mobile Switching Center (MSC) and the PSTN. MSC's were software modifications to existing switches with special mobility management and cell maintenance software imbedded in the proprietary switch. Once an operator selected a vendor, virtually no future choice existed to incorporate innovations from other vendors as cellular technology evolved. The only exception was at the subscriber unit level. As a consequence, while the subscriber unit prices (U.S) have declined approximately 20% per year due to intense competition from more than 20 competitors, voice channel prices have remained more or less constant. It is the author's opinion that this lack of

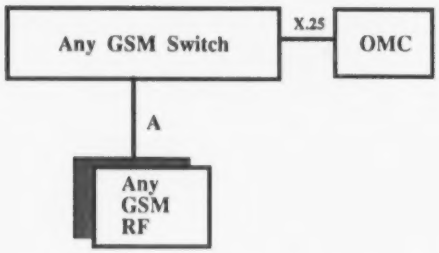
continuing competition within infrastructure, especially at the level of the voice channel, will keep infrastructure prices high and offer operators no incentive to add the new, more casual user to their network which is fundamental to further market penetration and, hence, industry growth. The remedy is to open up the key interfaces in the cellular infrastructure, particularly the base station to switch interface, generating competition at the voice channel level similar to what occurred with the standardization of the air interface at the subscriber unit level.

OPEN INFRASTRUCTURE-PROGRESS TO DATE

The GSM specification, at both 900 MHZ and 1800 MHZ, is by far the most mature in opening up key infrastructure interfaces. Figure 2 illustrates the GSM infrastructure specification which defines an open standard, "A", between the base station and switch and subtracts the cellular operations and maintenance function (OMC) from the switch. This permits the operators, for the first time, to separately select a switch vendor from a cell (Base Station & OMC) vendor, generating competition for voice channel prices.

Figure 2

GSM Architecture



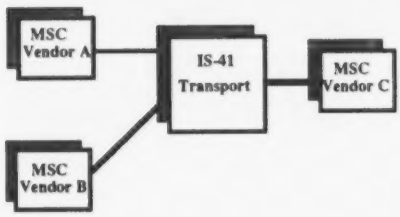
To date, Motorola is the only GSM infrastructure supplier which bids GSM cells (Base Stations & OMC) independent of the switch with the commitment to integrate the system with the switch vendor chosen by the operator. For example, GSM cellular systems utilizing Motorola cells and Siemens switches will be deployed in Sweden and United Kingdom late this year. In addition "A" interface testing and configuration agreements have been established with a number of other GSM switch vendors expanding the operator's choice of switch and cells.

As a consequence of adopting this open infrastructure architecture, GSM operators have seen a decline in prices per voice channel of more than 20% during the last year - a price learning curve which begins to approximate one that cellular subscriber units have been on for sometime.

Progress in open infrastructure standards in non-GSM markets has, to date, been limited. For the AMPS standard, the only notable advance is the introduction of the IS-41 specification which permits subscribers on one vendor's infrastructure system to roam to another. IS-41 as illustrated in Figure 3 is in the very early stages of introduction in the U.S. and will require a number of future revisions to match the feature/functionality of today's proprietary roaming protocols such as Motorola's DMX. IS-41 is an important first step in moving towards open architecture for the AMPS standard.

Figure 3

IS-41 Networking

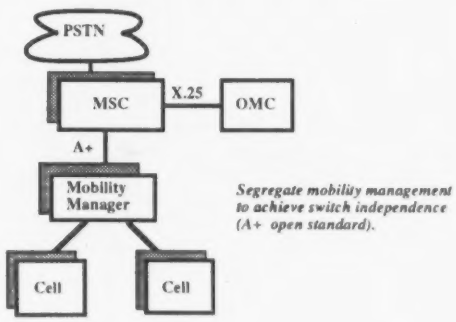


Digital specifications, other than GSM, such as USDC, CDMA, and Japan Digital do not yet accommodate open infrastructure interfaces although operator interest and pressure are growing in these areas. As was the experience in Europe with GSM, establishing these standards will require strong support of the operators.

Motorola is pioneering the introduction of open interfaces in these markets by evolving the GSM A specification to A+ where the "+" refers to modification required to accommodate the particular air interface specifications. Figure 4 illustrates this model of Motorola's Open Network Architecture (ONA).

Figure 4

Motorola ONA for Cellular



Here, in addition to the subtraction of cellular maintenance (OMC) from the switch as per the GSM specification, the mobility management (handoff, location registers, billing) is also subtracted from the switch and relegated to a mobility manager - a high capacity fault tolerant computer.

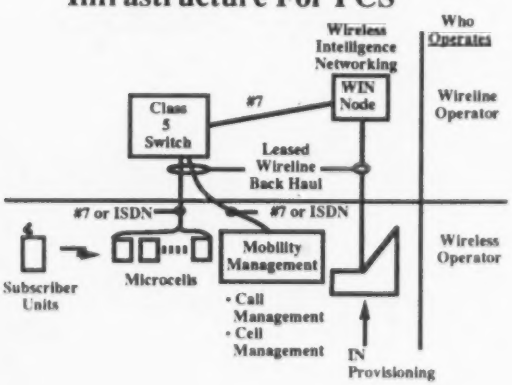
This architecture has a number of advantages to the operator. First, like GSM, it permits the independent selection of a switch and cell by the operators from those cell and switch vendors who adopt the A+ interface. Second, this architecture outboards some of the critical mobility management function from the switch to a computing platform which permits the introduction of new cellular functionality to be more independent of switch generic releases. In addition, this approach outboards some of the critical real-time intensive processing of cellular from the switch. This advantage is potentially a major one for operators since it places some of the critical busy hour attempt parameter of their system on a computer technology learning curve (typically 2X capacity every 18 months) versus a much slower switching capacity learning curve. This is especially important with the adoption of new digital air interface technologies which can require 2-3X switch processing real-time as their predecessor analog technologies.

PCN/PCS AND ONA

To this point in the discussion, the importance of ONA to cellular has been outlined for cellular. In a cellular topology relatively few high RF-powered cells are required for broad coverage, and hence, separate switching and cell site to switch transmission facilities can continue to be justified. However, for PCN/PCS, where the number of cells is expected to be 4-100X that of cellular (depending on the spectrum) the expense of totally separate transmission and switching infrastructure is prohibitive both in capital outlay and time to market. Therefore, the adoption of further open interfaces to "piggy-back" on existing infrastructure is, in the author's opinion, essential for PCN/PCS to be attractive. Figure 5 illustrates one approach, currently being discussed in the U.S.A., which permits a PCS service to be positioned on the existing PSTN infrastructure.

Figure 5

Utilizing Wireline Infrastructure For PCS



Here, the wireline local operating company provides both the microcell back haul for PCN/PCS and the switching. The wireless operator maintains operational independence by controlling the mobility manager, determining wireless feature functionality such as hand-off, roaming, customer features and billing. In addition, the wireless operator controls the OMC functionality to maintain cell sites and has an Intelligent Network (IN) provisioning capability to the PSTN to enable call routing between landline and wireless. This arrangement is economically attractive to the wireless operator only if the wireline operator provides attractive tariff rates for back-haul, virtual switching and IN functions. Considerable market pressures exist to achieve competitive tariff rates since the alternative for the wireline operator is to lose their 'dial tone' franchise for a considerable percentage of their users. Arrangements similar to this have been proposed in earlier literature (1) and will be utilized in Japan's experimental trial of handi-phone. (2)

SUMMARY

The proprietary infrastructure period for cellular is rapidly coming to a close. GSM has pioneered an open infrastructure specification which has already provided operators with a new level of vendor flexibility and intense competition at the voice channel level. Motorola is currently the only vendor which is actively propagating this standard extending it to other markets. The attractiveness of this arrangement to the operators makes its ultimate adoption inevitable. Further, PCN/PCS economics requires further evolution of open infrastructure interfaces in order to piggy-back on existing infrastructures. The day will come when a cell can be selected with a high degree of freedom. The resultant competition could put voice channel prices on about the same annual learning curve as subscriber unit prices and stimulate the growth of the entire industry.

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(1) Donald C. Cox, "Universal Portable Radio Communications," IEEE Transactions on Vehicular Technology, vol. VT-34, No. 3, August 1985.

(2) Radio System Development Center Foundation, Second Generation Cordless Telephone Systems Standard Specifications (Proposal). (Intermediate Version 0), (RCR STD-28), Do. G13-2, Tokyo, Japan, September 3, 1991.

CELLULAR SYSTEMS TECHNOLOGY: NARROW BAND DEVELOPMENT AND DIGITALLY ENHANCED CELLULAR SERVICES

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Abstract

Due to rapid subscriber growth, providing adequate cellular capacity has become a critical problem, especially in major metropolitan areas. Several proposed digital solutions are in the draft specification stage and will require significant additional validation, testing, and development time. A narrowband extension of the existing analog cellular AMPS system, termed NAMPS, is proposed to provide a technology bridge between AMPS and an ultimately adopted digital approach. The NAMPS approach affords immediate spectrum relief as well as a continuous digital messaging stream which provides some significant service and performance benefits to the user and operator alike. The technology is already tested and proven, providing an economical and low risk interim solution. Commercial subscriber equipment is already available to begin the crucial preloading phase.

Introduction

Cellular subscriber growth in the past five years has been nothing less than spectacular. Estimates now cite a sustained realistic growth opportunity of about 35%, while in recent years annual subscriber growth has peaked at numbers even twice this value.

Major metropolitan areas have felt the strain of this rapid subscriber growth. For the most part, cellular system operators have been able to keep up with this growth by adding channels. Since cellular systems are limited in allocated spectrum (and therefore the total number of available channels), subscribers in high density locations have been able to be accommodated only through careful application of geographic reuse, i.e. cell splitting.

However, limits in cell splitting are already being reached. In mature cellular systems, where capacity is most needed, the ability to find appropriate cell site locations has become problematic. Placement accuracy needed for co-channel reuse protection increases inversely with the desired cell size. Furthermore, when appropriate sites can be found, they can be prohibitively expensive.

Despite the operators' attempts at keeping up with demand, it is not uncommon during peak hours for users to be blocked from placing calls due to lack of available voice channels. Also, the greater amount of reused channels has increased the opportunity for interference which produces degraded audio quality and in extreme cases, dropped calls.

Users' expectations about cellular have evolved significantly. Initially offering essentially "car" telephone service, cellular has now evolved to providing personal communications. This is evidenced by the continuing trend away from mobile subscriber units towards portable devices which are now approaching 50% of cellular subscriber radio sales. The personal aspect of cellular will no doubt be enhanced as the cost, size, and weight of the physical radio continues to reduce and service availability, particularly in-building, becomes more ubiquitous.

Ultimate Digital Proposals

Several proposals have been offered for dealing with the cited capacity problems. These proposals have principally focussed on the radio air interface protocol. One proposal, for example, is a TDMA solution and provides, at the outset, three users for each AMPS channel exchanged. Another proposal utilizes wideband direct sequence CDMA and claims to offer potentially 10 to 20 times the capacity over conventional analog cellular. A considerable amount of controversy still surrounds the decision between these and other offered proposals. The discussion involves technical feasibility, merit, and cost for each approach as well as subscriber implementation viability.

While draft standards exist for both of these above proposals, there has yet to be any significant field or market trial for either technology. Considering the radical departure of these techniques from that currently utilized with AMPS, or any other existing cellular systems worldwide, considerable care in the adoption process should be exercised.

The problem currently facing cellular operators and manufacturers is making a final decision on which proposed solution to ultimately embrace. Limited testing for both proposals is in process but considerably more testing is still necessary. The original AMPS specification went through extensive trials in Chicago and Washington / Baltimore to validate the specification. This evaluation involved some 2500 subscriber units and uncovered some 8000 problems. The GSM digital cellular system development in Europe is likewise following a specification development schedule having provisions for adequate testing. This plan included a validation exercise to establish specification consistency, correctness, and completeness. Furthermore, it provides for a pre-operational phase for final testing prior to commercial release.

Without a doubt, equipment suppliers will be particularly cautious before totally embracing any final solution. Any selected approach needs overall industry acceptance. Subscribers are accustomed to a particular size/weight package and will not pay significantly more without some apparent benefits. Any successful deployment of equipment will demand some significant movement down the development experience curves to achieve the necessary cost reductions and capabilities. Achieving the minimum expectation levels for subscribers with so much new technology will require considerable up front investment. There will be some hesitancy to move forward too rapidly so that necessary specification changes can be found in a timely manner and not cause a major development redirection. Therefore, there is a strong desire to find low risk approaches that would avoid any opportunity for operational problems.

The radio technology required to implement any fully digital cellular technique is known to depart significantly from existing radio designs. Implementations will heavily exploit digital signal processing techniques to affect the necessary speech and channel error correction and detection coding as well as provide compensation for mobile radio channel multipath that exists in the real world. Radios will need to be dual mode, i.e. capable of both the AMPS and new digital format. RF, IF, and backend processing differences in both the receivers and transmitters will demand unique solutions that will burden subscriber units with some degree of circuit and function duplication needed to accommodate both systems. Simply stated, first generation digital equipment will not be of the same ilk as that is now available for AMPS.

The dual mode compatibility issue is key when dealing with a spectrum management situation as is the case for AMPS. The rapid deployment of subscriber units having the new, higher capacity, technology is crucial to achieving the desired capacity increase. Significant increases are only realized after a substantial fraction of the subscriber base are capable of the newer technology. The graph of Figure 1 illustrates this fact by showing the capacity advantage gained at a cell site where a new technology displaces single-user AMPS channels to provide 3 users. Dual mode capability is assumed, that is, overflow occurs from subscribers having the 3:1 technology to the AMPS channels, but not vice versa. The graph shows that a 2:1 overall system capacity improvement is realized only when over 70% of the subscriber base has been penetrated with higher capacity radios and 45% of the AMPS channels have been converted.

NAMPS

As the debate for an ultimate standard continues, there exists an immediate need for spectrum relief in some areas. No ultimate, fully validated digital solution is yet ready. Even if a validated specification was now in hand, no commercial subscriber equipment of the type, quantity needed to provide the necessary preload is close to commercial reality. This suggests the application of some bridging technology approach to meet the immediate capacity needs while maintaining the opportunity to transition to a future, ultimate digital solution.

Narrowband AMPS (NAMPS) is proposed in this paper to provide this necessary capacity relief while at the same time providing some desirable user and operator advantages. NAMPS is a digitally enhanced version of the proven AMPS standard. A unique combination of current analog voice processing and associated digital signaling, it allows tripling number of cellular channels in addition to providing performance enhancements and enhanced digital services.

NAMPS achieves its 3:1 channel increase over AMPS by splitting each AMPS 30 kHz. channel into three subbands and assigning each subband to a different user. Voice deviation is reduced to maintain a narrower channel bandwidth. Control channel signaling for NAMPS is the same as for conventional AMPS.

In addition to the spectrum splitting, NAMPS encompasses an additional differences. A continuous, high reliability, 200 bit/s signaling channel is added that is transparently communicated in an unused portion of the modulated spectrum below the speech spectrum. This channel serves to provide all necessary digital messaging for call processing, system control (power control, handoff, etc.), and supervision. This continuous data channel permits additional improvements, including the provision of enhanced data services and reporting of subscriber detected interference.

A summary comparison of some key radio specification differences between AMPS and NAMPS is provided in Figure 2.

User Perceived NAMPS Improvements

The digital subaudible signaling that NAMPS employs allows control information to pass between the base and subscriber continuously and is transparent to the user. In AMPS, conveyance of signaling information, (such as handover and power control commands) demands "stealing" the traffic channel momentarily from the conversation, which is often noticeable to the user as noise or muting.

The supervision of a conventional AMPS call hinges on the use of only 3 supervisory audio tones that are placed above the voice audio spectrum. With NAMPS, an expanded set of codes is provided by way of the subaudible signaling. This flexibility, in addition to the enhanced reliability of the protocol, reduces the likelihood of supervision detection errors in periods of low signal strength or interference. This ultimately results in improved call quality, fewer dropped calls, less susceptibility to anomalous propagation or frequency planning errors, etc. Message orders, including handoff commands, are verified with an ARQ protocol to provide positive confirmation.

Cellular system operation is notoriously nonreciprocal. For a particular call, the interference a mobile experiences can be quite different than the interference experienced by its serving base. With conventional AMPS, there is no provision permitting the subscriber to inform the network that interference or noise is detected. With NAMPS, the continuous subaudible signaling provides a mechanism affording this enhanced capability. For one, the downlink signaling itself furnishes the subscriber a convenient means for assessing the quality of the channel. Then, the reverse signaling channel provides transport to report this measured information to the base. This procedure is termed Mobile Reported Interference (MRI). The system can react to quality reports by performing some corrective action such as boosting the base station power to the subscriber or handing the call off to a different frequency or cell.

Quantitative performance improvements provided by MRI have been obtained by extensive computer simulation and field testing. Audio quality is related to the C/I ratio a subscriber experiences. For analog, audio becomes degraded when the C/I drops below 17 dB which can occur when systems are experiencing heavy utilization or the user wanders to noisy locations. Proper utilization of NAMPS MRI with corrective action by the network can reduce the time spent with degraded audio nearly five fold. Simulations further suggest that time spent below 10 dB C/I (often considered the "dropped call threshold") might be reduced even more. With MRI improvements, the NAMPS system audio quality will on the average be better than AMPS system audio quality.

With NAMPS, the required radio signal bandwidth is reduced and therefore less noise is associated with each user channel, that is, there is improved signal to noise performance in comparison to AMPS. This improved NAMPS radio sensitivity suggests greater range and deeper in-building penetration.

Operator Perceived NAMPS Improvements

NAMPS provides significant benefits to the cellular system operator. It is an economical, low risk, means of enhancing channel capacity up to three times that of AMPS. Upgrading an existing site avoids entirely the time consuming effort and expense associated with obtaining a new site. Since fewer sites are involved, maintenance costs are reduced and trunking efficiencies of backhaul trunks can be increased.

In many cases, an upgrade at a cell site might be very simple. It may only involve the installation of some new transceivers, scanning equipment, and software.

As cited above, the enhanced NAMPS performance will lead to a better grade of service to the customer. In particular, channels will be more readily available, the number of dropped calls will be reduced dramatically, audio quality will be improved, and coverage will be enhanced. The net result will be a happier customer and improved revenues.

Any capacity enhancement afforded the operator adds flexibility that would otherwise not exist. For example, the existence of "extra" channels permits the operator to reserve channels for special usage, including unique coverage solutions, "private" systems, etc.

Digitally Enhanced Services

The continuous, digital, full duplex, subaudible signaling channel that NAMPS exploits provides the operator a competitive advantage. Customers can be offered value added and revenue generating digital message supplementary services. For example, a short message service would allow the communication to a user of a brief digital message such as the calling party's number. Paging services can be provided, with acknowledgement. Dispatch operators might utilize the short message with predetermined inquiries and responses to communicate with their fleet. The user could also be provided continuous status indications, such as "voice mail waiting". "Group page" capability allows a dispatcher the ability to signal his entire fleet of users at once. All these enhancements are made possible through the use of the NAMPS signaling channel.

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NAMPS Frequency Planning

The impact of NAMPS on frequency planning aspects has been exhaustively characterized. Despite the reduced deviation, it has been demonstrated that NAMPS operates with any of the typical frequency reuse patterns employed today with AMPS. Due to the stated operational improvements, NAMPS link quality will be generally better than conventional wideband channels. Frequency assignments are made with the rules similar to those used for current AMPS systems. All three NAMPS channels that occupy an AMPS channel are considered cochannel to only one AMPS channel. Furthermore, a single 10 kHz NAMPS guard channel is all that is necessary to protect an adjacent AMPS channel from NAMPS spectrum.

NAMPS as a Bridge to Digital

It is the inevitable future transition to an ultimate digital cellular solution within the allocated spectrum that makes the compelling argument for NAMPS. NAMPS can be immediately deployed with low cost subscriber radios that operate with either the conventional AMPS format or the higher capacity NAMPS format. Dual mode operation allows system controlled switching between the two formats in a way that is transparent to the user. This will allow the adequate time necessary to thoroughly "shake-out" the digital cellular approach.

As the subscriber base becomes penetrated with dual mode NAMPS radios, it is possible to reallocate cleared channels which are needed to implement evolving digital technology. In light of the enhanced capacity and performance afforded by NAMPS, the transition is accomplished in a nondisruptive manner while maintaining a high grade of service to all users.

NAMPS Deployment Status

A considerable amount of effort has already been invested in validating and field testing the NAMPS approach. Extensive simulations and laboratory bench testing have been conducted to support the specification's development. Performance improvements have been verified through the use of both internal and independent audio quality (mean opinion score - MOS) testing assessments.

With regard to actual field testing, by August of 1991, Centel Cellular and Motorola had already completed an evaluation using a portion of the Las Vegas cellular service area. Expansion of the number of converted sites is already planned for the near future.

The NAMPS concept is not an entirely new one. A similar split-channel technology, NTACS, is currently commercially deployed in Osaka, Japan. On a technical basis there is a striking similarity between NAMPS and NTACS, including the use of a continuous subaudible signaling channel. The essential difference is that NTACS is a 2:1 split of the existing Japan TACS system, which is based on 25 kHz. (vs AMPS' 30 kHz.) spaced channels. The NTACS system has been exhaustively tested in Osaka's nearly 100% portable challenging RF environment with nearly 100 % portable users. The NTACS standard enjoys subscriber unit sourcing from at least six manufacturers.

The ability to meet immediate customer expectations for low cost, size, and weight portables is also assured. As an extension of the existing AMPS system, it is possible to directly leverage the technology of existing analog portables, which have already advanced rapidly down aggressive product experience curves. This is evidenced by the recent announcement and significant shipments of Motorola's 7.7 ounce, NAMPS-compatible, MicroTAC Lite™.

The NAMPS specification is an open standard. Licenses for essential technology to implement the standard have been offered, royalty-free, to all subscriber and infrastructure equipment manufacturers. Already, some 27 licenses have already been requested.

Summary

NAMPS technology affords an immediate solution to effectively more than triple the capacity of cellular systems. It supports the requirement of providing a dual mode solution with portables that meet the user expectations regarding cost, size, weight and talk time. Besides capacity advantages, it affords a cost effective means to improve system quality and simultaneously provide new subscriber services. NAMPS is based on proven technology and provides a low risk, gracefully evolution path towards an ultimate digital cellular solution as it becomes available.

Acknowledgements

The authors wish to thank John Thode and Dennis Schaeffer for their assistance on this paper.

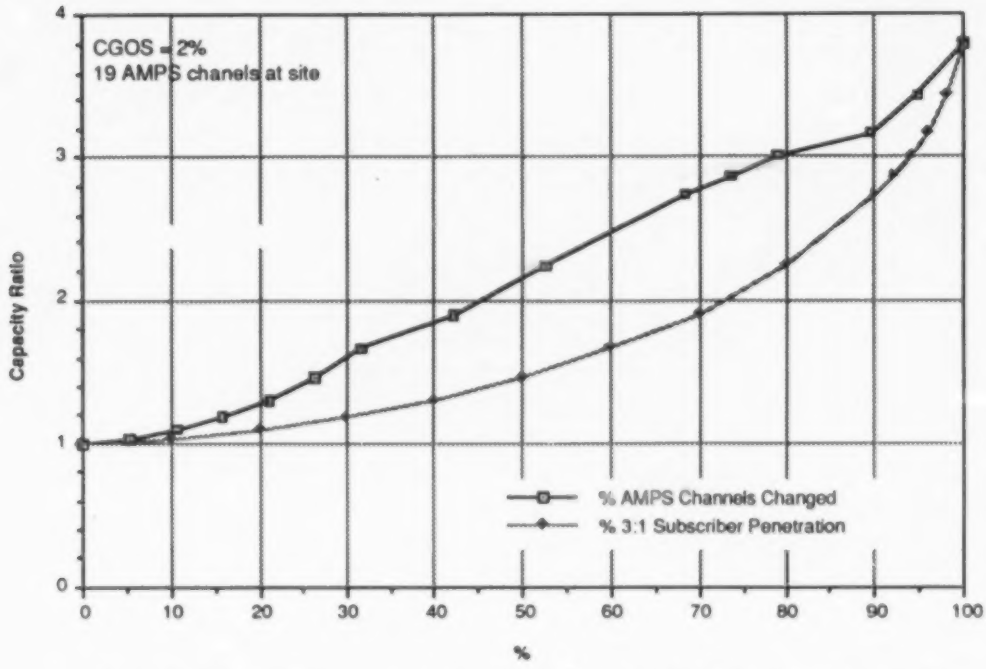

Figure 1. Capacity Improvement with 3:1 (Dual Mode) Subscriber Penetration

PARAMETER	AMPS	NAMPS
Paging and Access Channel	10 kbit/s Manchester	10 kbit/s Manchester
Voice Channel Signaling	10 kbit/s Manchester	100 bit/s Manchester
Supervisory Signaling	6 khz Supervisory Audio Tone	200 bit/s NRZ data stream
Supervisory Deviation	2 kHz	700 Hz
Peak Voice Deviation	12 kHz	5 kHz
Average Voice Deviation	2.9 kHz	1.5 kHz
Frequency Stability	2.5 ppm	1 ppm (AFC optional)
Adjacent Channel Frequency	30 kHz	10 kHz
Adjacent Channel Selectivity	16 dB	18 dB
Intermodulation (2&4 channel)	65 dB	65 dB
12 dB SINAD	-116 dBm	-118 dBm

Figure 2. Comparison of AMPS AND NAMPS Radio Parameters

PERSONAL COMMUNICATIONS: POTENTIAL AND PITFALLS

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1. ABSTRACT

The promise of Personal Communications has the potential to change the shape of world-wide telecommunications over the next decade. Technologies driving these changes could benefit developing countries, enabling them to establish new infrastructures and employ low-cost terminals. Several issues must be addressed if the potential is to be realized. Failure to resolve these issues could delay the implementation of the full benefits of Personal Communications. If costs remain high, because of limited public adoption of these new services, developing countries may not be able to take advantage of the potential.

2. INTRODUCTION

Personal communications networks and services have the potential to bring dramatic changes to the provision and use of telecommunications. The magnitude of these changes has been compared to the impact that the personal computer had on society in the 1980s. The technologies which will bring about these changes also have the potential to bring low cost telecommunications to those parts of the world yet to fully participate in the communications age. The potential is real, but there are many issues to be addressed if that potential is to be realized.

3. THE VISION OF PERSONAL COMMUNICATIONS

The promise of personal communications is best captured in the vision:

"The ability to communicate with anyone, anywhere at anytime".

Variations of this vision can be found in many published predictions of evolving mobile services. However, the fine print often contains limitations on the vision which restricts its full potential. There may be restrictions on the availability of bandwidth, geographical constraints, limitations due to the cost of equipment or services or simply assumptions that other services will be in place to support the new services.

A combination of factors are critical to the further development of personal communications networks (PCNs). Examples of these factors are:

- the introduction of the powerful attributes of "intelligent" networks;
- the introduction of the "personal" number;
- significant reductions in the cost of mobile and fixed user terminals;
- the assignment of radio frequency spectrum.

A characteristic of personal communications which makes the service truly "personal" is the ability of the user to define services to fit his or her personal needs and requirements. Telecommunications services become personal in the same way as a computer is personal - users chose what they want the system to do for them.

At present two quite different forms of personal communications are converging. One, "untethered" or wireless/mobile communications, is the world of the cellular and cordless telephone and the wireless pager. The other, "tethered" communications, is the computer communications world. This is the result of yet another convergence, computers and communications, around virtually unlimited computer memory and the increasing availability of low cost communications bandwidth. An emerging, if ill defined, "buzz-word" in this world is "multimedia" communications. The two worlds

are quite different, yet to the user they could come together around at least three attributes.

3.1 PERSONALIZATION

The personalization of networks and services using the intelligence in the "intelligent network" through easy to use interfaces. The user defines the system parameters in a way analagous to setting the parameters of a personal computer. Simple examples could be instructions to the network to:

- direct all calls (from a user defined list of names) from your home to wherever you are travelling;
- provide exactly the right amount of bandwidth to send your real-time video transmission from Toronto to San Francisco at a specified time of day;

This "personalization" contains the key characteristic of personal communications - communications will be to a person rather than a place. The network will be capable of universally identifying individuals.

3.2 INDEPENDENCE OF PLACE

Independence of place implies the use of standardized (multimedia) terminals analogous to the conventional telephone set. After an initial orientation, the use of a terminal in someone else's office, car or on public transportation would require no training or special instructions. This will be particularly important if the growth of mobile use achieves predicted levels.

3.3 THE SEAMLESS CONNECTION

The "seamless" connection of people to people (or to information sources). The user should be able to assume that the connection between terminals, networks and people is virtually direct. In existing networks this can be taken for granted for voice, data and facsimile services. However, such apparently "seamless" connections are more likely the result of interconnecting agreements which may be masking the reality - that many systems are not compatible and seamlessness for wide band services may be difficult.

Theoretically the combination of global networks with these attributes would provide universal access and the possibility of participation by all - by customers in both the industrialized and the developing world.

4. AN OPPORTUNITY TO BRIDGE "THE MISSING LINK"

The enormous gap between telecommunications infrastructures and services in the industrialized and the developing worlds was highlighted in the 1985 report of The Maitland Commission, The Missing Link . The Commission was tasked with recommending " ...a range of methods including novel ones for stimulating telecommunications development in the developing world using appropriate and proven technologies" and provided a set of recommendations aimed at bringing significant improvements in telecommunications world-wide. Personal communications technologies, not even predicted in 1985, have the potential to add a new dimensions to the range of options suggested in the Maitland Report.

One can expect a range of new technologies to emerge as personal communications evolves, but already two elements in PCNs offer promise. The first is the possibility of low cost "mass production" terminals. The second is the millimeter-wave links that will be required, in at least early systems, to interconnect base transceiver systems to the base station controllers.

Combinations of these elements could provide a fast, cost effective method of providing basic telephone service - a cheap alternative to the installation of conventional telephone network infrastructures. A reduction of infrastructure costs could be of great importance to developing countries either as a temporary arrangement or as a way of "leapfrogging" over traditional approaches.

The feasibility of employing these methods is dependent on the cost of equipment, systems and software. An appropriate range of costs for terminals can likely be achieved if they become a mass market item. The millimeter wave links, controllers and base transceiver cellular systems costs will depend on the extent to which PCNs become established in the industrialized world.

4.0 CONSUMER ACCEPTANCE

In short, the availability of low cost equipment for the developing countries will be driven by mass consumer and business user acceptance of Personal Communications in the industrialized world. However, consumer acceptance in the industrialized world, although of course driven by cost, is likely to be affected by other considerations. Some of these are intangibles. Example of three of many areas that will need to be addressed are as follows:

4.1 THE PERSONAL NUMBER

The introduction of a personal number, unique to an individual and valid for life, coupled with the flexibility offered by the intelligent network, changes the relationship of people to communications services. For example, the receiving party, rather than the originator in a communications link will be able to control the communications. Most people would argue that this is necessary and desirable from the viewpoint of individual choice and personal privacy. However, new responsibilities will have to be defined and accepted by users. At one level, some entity has to asign the personal number - does this entity own the number, and if so, what are their obligations?

In a global system where a user has the power to instruct the network to forward calls to the other side of the world, what are the obligations of the user? If a third party calls my office in Canada, and the network connects the party to me, travelling in Australia, are the long distance charges my responsibility or his? These issues can be resolved, but the resolution may not be easy, nor readily accepted by users.

4.2 TOO MANY OPTIONS?

The plethora of options that could be made available to customers in the ultimate personal communications environment threatens to confuse all but the most sophisticated of user. The ability to personally define services involving different locations, media and other variables might well be a mixed blessing if the result is a consumer backlash. If easy access and easy to use terminals are to be a selling points for personal communications, there will need to be a structuring of features, perhaps aligned to lifestyle, price or other criteria.

4.3 TRANSPARENCY

Transparency between the tethered and untethered world may be a reality for voice and narrowband services, but that is not yet the case for wideband and multimedia services. Some wireless based "in-building" technologies (e.g. wireless LANs, cordless PABXs) will permit an in-building mobility more closely related to the tethered than the untethered world. This might well raise expectations, initially from the office or private telecommunications sector, that there should be an identical range of services in both the tethered and the untethered worlds. Unfortunately, the untethered user, dependent on the RF spectrum, is likely to be severely bandwidth constrained both by spectrum limitations and by the characteristics of radio based communications. Advances in compression technologies may help to overcome these disadvantages in part, but there will for some time be a disparity between the individual using the radic frequency spectrum and the individual who is using tethered communications.

These "public acceptance" factors will be relevant in the long term but in the immediate future technical and international standards questions are setting the pace for the introduction of the new personal services.

5.0 THE STATUS OF PCN

The technical characteristics of emerging Personal Communications Networks can be gleaned from published papers and from International Telecommunication Union (ITU) documents. The ITU papers in particular have stressed the need for internationally agreed standards, such as a common world-wide radio interface and frequency band. Among a host of issues to be addressed, spectrum, standards and access methods seem to be dictating the speed and form which the early personal communications networks will take.

5.1 SPECTRUM

The spectrum issues will be addressed at the forthcoming 1992 ITU World Administrative Radio Conference. Any changes in spectrum allocation approved internationally at the WARC will then need to be reflected in domestic allocations.

5.2 STANDARDS

While there has been some recent loss of momentum, the development of standards has moved ahead quite rapidly. In Europe, the approval by the European Telecommunications Standards Institute (ETSI) of the Digital Cellular System Standard (DCS1800) has provided a basis for the evolution of PCN in Europe. Several PCN trials are underway in North America.

5.3 ACCESS METHODS

Access methods continue to generate a lively discussion with, in the United States, a debate over Time Division Multiple Access (TDMA) and Code Division Multiple Access (CDMA) or spread spectrum.

5.4 MIGRATION TO DIGITAL

These developments are further complicated by concerns that there may be delays in migrating to the new digital services leading to Personal Communications because of the heavy embedded investment in analog systems. If delays are too long, other low cost alternatives, such as the public pay phone or pay fax, may further influence the rate of introduction of these services.

5.5 ACCEPTANCE IN DEVELOPING COUNTRIES

Developing countries have already demonstrated a willingness to adopt technologies to meet their needs through the use of existing mobile, cellular and satellite services. Personal communications promises to allow this trend to continue, but at considerably reduced cost and potentially greater impact.

6.0 MULTIMEDIA

Finally, on the tethered side, bandwidth, the limiting factor for multi-media applications is likely to become more readily available in the near future. Access to T1 or T3 capacities, or simply access to bandwidth on demand may soon be an option available to individual users, with appropriate tariffs to match. Bandwidth might soon be an opportunity, rather than a limitation.

7.0 SUMMARY

Each of these factors, among many others, will determine the evolution of personal communications, its public acceptance and ultimately its price. The developing world will be watching its evolution with some interest - if the price is right, these technologies might help to solve some long standing problems.

8.0 CONCLUSION

The potential of achieving the full potential of Personal Communications may not be fully realized unless global international standards and public acceptance are assured. Several "pitfalls" are evident which could prevent the benefits of Personal Communications being realized in the developing world. Factors which would bring about cost reductions need to be addressed if developing countries are to benefit from these new directions.

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Standards and the Evolution of Wireless Services

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ABSTRACT

Adherence to standards has been critical to the success of cellular in the United States and support of the GSM digital standard has greatly effected the speed at which this new technology is being implemented in Europe and the Pacific Rim. However, market confusion on digital cellular standards in the U. S. has created significant delay in digital developments for that country. Other countries, and wireless operators and manufacturers, should strive to minimize this kind of confusion when evolving their wireless and wired networks toward more advanced spectrum utilization technologies and service capabilities such as PCS.

1. Adherence to Standards

1.1 Analog success in the United States

The adherence to industry developed standards has been critical to the success of analog cellular in the United States. Analog cellular systems in Europe were independently developed and standardized in each country, while all U.S. cellular operators built to a single specification. The resulting economies of scale have led to greatly reduced terminal rates and an impressive growth rate. U.S. cellular subscribers have increased from less that 1 million in 1985 to 6.3 million cellular subscribers in early 1991. Over the same time period, European systems have only added 3.8 million customers.

1.2 Digital success in Europe

The European community has taken this problem into account in the standardization of its next generation -- or digital cellular systems. Adherence to the GSM standard for digital cellular has encouraged the relatively speedy development of this technology. There are now GSM systems operating in Germany and Finland and BellSouth is due to turn on a GSM system in Denmark in March, 1992.

The first standard setting meetings were held in Europe as early as December 1982 and by September of 1987 the first Memoradum of Understanding meetings were held. By starting early, and allowing for this 10 year planning period, the European community avoided the confusion of competing standards once the need for service became critical.

While GSM was originally touted for its pan-European capabilities, this may not be its most important charecteristic. Of more profound significance may be its effect on economies of scale for manufacturers which will lead to lower equipment prices and stimulation of demand.

1.3 Lack of Standard Support: U.S. Digital

Conversely, market confusion about digital cellular standards in the U.S. has contributed to significant delays in the availability of digital cellular equipment. In 1987, CTIA and TIA formed various committees to consider a digital standard for U.S. cellular. They had two major requirements: the technology must be deliverable by December 31, 1991 and it must be compatible with the existing AMPs technology. This compatibility issue is the major reason U.S. cellular could not use a GSM type digital system. After a heated debate among FDMA and TDMA technologies, the TIA formally endorsed TDMA as the industry standard in September of 1990.

A few months later, Qualcomm and PacTel announced that they were running tests on a spread spectrum technology called CDMA which they said could also make the specified date and would provide much greater capacity increases. This announcement came at a time when the industry was just realizing some of the difficulties associated with the reality of TDMA. The next year, when it became clear that CDMA would run at least 18 months later that the December 31, 1991 date, Motorola announced a narrow band AMPs technology that could be implemented quickly and easily. Though each of the air interface technologies being discussed in the U.S. -- TDMA, CDMA, and N-AMPs -- has its merits, BellSouth firmly supports the deployment of the agreed upon standard, TDMA.

Testing by one of our cellular operating concerns in Los Angeles and test data from Southwestern Bell indicate that the technology is sound, that voice quality is good and that capacity increases will initially be in the 3 to 4 times range. This does not imply that either CDMA or N-AMPs are not suitable alternatives in other markets or situations, and BellSouth is closely monitoring the CDMA testing in San Diego and the N-AMPs testing in Las Vegas. Either of the technologies might be the right decision in one of our markets outside of the U.S.

However, the Los Angeles and Southwestern Bell tests do support TDMA's qualifications as the standard for U.S. digital cellular. BellSouth hopes that more carriers and manufacturers can join its support of this standard in the U.S. and thus speed up the delivery dates and drive down the cost of TDMA dual-mode handsets.

To achieve a standard, an industry must put a stake in the ground and adopt a standard that will meet that goal. If one continues to move the stake for the standard forward, no one ever gets around to building and supporting the technology. In many ways, this is the best argument for the support of TDMA. GSM is not the most spectrally efficient standard imaginable, and TDMA may not be either, but they both supply adequate capacity increases. Cutting off the specualtion period and moving on to the implementation of these systems will allow service providers to begin the important business of supplying their customers.

In the U.S., and around the world, telecommunications providers must keep in mind that technology is transparent to the customer. But market growth depends on providing services that answer the customers needs. We need to all agree on standards so that carriers can get beyond technology and concentrate on developing and providing service.

2. Global Standards

Though BellSouth is a firm supporter of system standards within large geographic areas, and we see the merit in economies of scale of countries like Australia and New Zealand adopting the European GSM standard, we are not yet convinced that a single, global standard is a necessity. The "international roamer" market is a very small one and its size does not seem to justify the considerable expense needed to implement such a worldwide system. There is the possibility of a premium service of this sort, but the prospect is still very expensive and the process of getting agreement of the many regulatory and provider groups involved is incredibly complex. More over, technical advances may allow for multi-mode terminals for the small number of users that travel extensively.

3. The Standards Process

The standards process provides obvious benefits to both network operators and their customers; but it has drawbacks. BellSouth participates in a number of standard setting bodies including T1, CCIR, CCITT, WARC, CTIA and TIA. We are also a signator to GSM. It has been our experience that the length of the process and the complexity of integrating the requirements of disparate industry factions have a potential to slow or disrupt the process. One possible means of smoothing the process is to develop standards for systems that can be evolved to greater complexity overtime. However, it is important to remember that the second generation of a system -- such as a digital cellular systems being implemented where an analog system already exists -- must provide all of the services available on the existing system, plus new services, in order to meet customers expectations. This also allows the service provider to create product differentiation in order to sell new generation phones which are or might be more expensive.

4. Future Standards Needs

Many of what we today consider to be personal communications services will be provided over digital cellular networks. As we have discussed, the development of standards can greatly speed the deployment of these networks and enhance their interoperability.

Evolution toward "personal communication services" will focus additional attention on the standards issue. The wireless networks of the future must allow a wide variety of networks to interconnect in order to provide each customer with the services and functionality they desire wherever they might be. In-building systems must interconnect with public systems and many systems will need to connect to and take advantage of the intelligent network features of the wireline network. Institution of and adherence to standards will facilitate this sort of interconnecting and ubiquity of service.

INNOVATION, EDUCATION AND RESEARCH AT A DISTANCE: "THE SCIENCE OF HUMAN NUTRITION" (FOOD SCIENCE AND HUMAN NUTRITION 285)

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U.S.A.

ABSTRACT

"The Science of Human Nutrition"/FSHN285 is a 3-credit introductory nutrition course, currently taught to over 300 students at the University of Hawai'i at Manoa (UHM) each semester. During the summers of 1990 and 1991, the class has also been successfully piloted as a Hawai'i Interactive Television System (HITS) offering to several remote sites as a two-way audio/two-way video course. Education and research have been combined in the two past HITS courses, in order both to define the student population served and to describe their nutrition knowledge and nutrition-related behaviors. In addition, the video tapes from the lectures can eventually be used as supplementary materials for similar courses being developed at several sites in the American Pacific.

1.0 INTRODUCTION

An essential function of the University of Hawai'i (UH) is to provide equal access to quality post-high school education to all qualified people in the state (1). However, the UH is unique among state land-grant institutions because of the geographic location of Hawai'i. The fact that we live on a group of islands in the middle of a vast body of water, the Pacific Ocean, creates special challenges and opportunities for those of us involved in addressing this mission of equal access to a college and university education for Hawai'i's people.

In this paper, we will describe an on-going collaborative effort between the Department of Food Sciences and Human Nutrition (FSHN) and the Office of Information Technology (OIT) both at UH-Manoa. Included in the discussion will be a description of "The Science of Human Nutrition"/FSHN 285 classes on interactive television, both past and proposed, and the major educational and research objectives associated with the course. In addition, we will describe future research plans for FSHN 285 on HITS and the use of the most current set of video tapes in other distance education courses.

2.0 HAWAI'I INTERACTIVE TELEVISION SYSTEM/HITS

HITS is a 4-channel inter-island closed circuit network in Hawai'i which has been designed as an electronic bridge for interactive telecommunication. Users of the system are defined as the University of Hawai'i, the Hawai'i State Department of Education and its public system, and other Hawai'i state agencies (2). At UH-Manoa, OIT maintains management and programming responsibilities for HITS for the total UH system.

An instructor using HITS can reach learners assembled at the same time in classroom sites throughout the state; and, through Cable TV, the instructor may even reach learners in their homes and at their work sites. In addition, video or telephone links from remote classrooms enable distance learners to interact with the instructor while the class is in progress or at other preset times. Because it connects all UH campuses, HITS is a powerful telecommunication tool which can help equalize opportunities in higher education for residents across the islands that comprise the state of Hawai'i.

3.0 "THE SCIENCE OF HUMAN NUTRITION"/FSHN 285

FSHN 285 is an undergraduate level, 3-credit course, which is listed as part of the UH-Manoa Natural Science core. The course attracts mostly students who are <u>not</u> majoring in food science or human nutrition; only about 10% of the students are currently enrolled as majors in the FSHN department. No college level science background is required; rather the course covers elementary aspects of the several biological sciences (e.g., biochemistry, anatomy, physiology) that are needed to understand the course content. Lastly, the enrollment in the course during the regular sessions has been increasing for the past two and a half years, by about 30-50 students per

semester. In fall 1989, about 140 students completed the course; this fall semester (1991), over 300 students were enrolled.

The content of FSHN 285 includes information about characteristics of nutrients and what they, and what the foods that contain them, do for humans. We also discuss how a healthy individual can choose an appropriate diet throughout the life span, and how humans and environmental factors can change foods and their nutrient content. In addition, we keep the information presented in the course as up-to-date as possible by including topics of current interest, such as a recent contest on the quality of water from various localities in the state, or continuing reports of Ciguatera toxicity in specific Hawai'ian reef fish.

4.0 PILOTING FSHN 285 ON HITS: SUMMER SESSION 1990

FSHN 285 has been offered on HITS as a course in both summer 1990 and summer 1991; it is scheduled to be offered on HITS again as a five-day-a-week, six-week summer session class in summer 1992. We identified four main objectives for our 1990 pilot offering. First, we wanted to compare the students attracted to the summer session course to those students who attend the class during the regular fall-spring sessions. Second, we needed to measure how successful we were in teaching the information. Third, we expected to use this pilot course to decide if it would be feasible to continue offering FSHN 285 on HITS. And, lastly, because we would have video tapes of the lecturer and of the students in the classroom, we planned to analyze the students' behaviors with respect to learning and learning styles and compare them across receive sites.

The experimental design was to have allowed a 2 x 2 analysis of variance of the data, because we were able to manipulate the mode of interaction between instructor and student and we had both on-island receive sites (UH-Manoa, live and remote studios; Leeward Community College) and off-island receive sites (UH-Hilo: Maui Community College). Unfortunately, because of insufficient registrants at two sites, we were unable to perform all the statistical analyses on the data that we had initially planned. We were able, however, to compare summer session students with the students who attended FSHN 285 during the regular sessions in 1990, using data from anonymous in-class questionnaires (return rate consistently 60-70%). The summer session students were older in years, were academically more advanced, and reported a wider variety of academic majors than did the regular session students. The majority (70%) of the students in all sessions were female, were not FSHN majors and were using the course to meet the UH-Manoa natural science core requirement. There was also a statistically significant trend across 1990: as the year progressed, the reported number of previous science courses completed before FSHN 285 decreased, perhaps indicative of the increase in enrollment of non-majors.

Information about nutrition-related habits was collected from all 1990 classes by means of an anonymous, voluntary questionnaire. There were no reported differences between spring, summer, and winter students with respect to current eating practices, eating episodes/day and eating styles. Most students reported that they knew they were eating a healthful diet, or that they wanted to now how to eat appropriately...both responses being indicative of a concern with adequacy or healthfulness of intake. In addition, the majority of the students stated that they ate 3-4 times a day and described their diet as "omnivorous."

Between 40-50% of all the students who completed the questionnaire reported that they were satisfied, within 5 lbs, with their current body weight; another 40-50% of the students wanted to lost at least 5 lbs; and the remaining 10% wanted to gain at least 5 lbs. Over 50% of the students never or seldom used vitamin/mineral supplements; the remainder were evenly divided between answers of "usually yes", "every day" and "only when not well." Similarly, reported alcohol usage did not differ between the three classes. The vast majority (over 80%) of the students reported seldom or never using alcohol. Most of the other students recorded 1-2 episodes of alcohol use each week. Finally, there are consistently about 20% of the students who report binge/purge behaviors, indicative of the eating disorder, bulimia. A few, about 6% of the respondents, reported engaging in these abusive behaviors as often as once each day.

Summer session students did differ from regular session students, in 1990, on two measures of dietary habits. More summer session students reported that they were, themselves, responsible for the majority of their food preparation when compared to the regular session student. In addition, the summer students relied more heavily on popular media than on friends or parents for nutrition information; the regular session students relied more heavily on friends and parents.

In order to determine the degree of success of the pilot class and to assess the feasibility of future FSHN 285 offerings on HITS, we examined the distribution of examination scores for

regular and summer session students. There were no significant differences among the examination scores or among the final grade distributions across 1990. Thus, we considered the HITS class to be as effective as the non-HITS classes for teaching the information in FSHN 285, and we agreed that the interactive TV class should continue to be offered the following summer. We were, however, unable to draw any conclusions regarding learning styles between receive sites, because as mentioned above, the distribution of students across sites made valid statistical analyses impossible.

5.0 RESEARCH CONTINUED: SUMMER SESSION 1991

Because of scheduling difficulties in summer 1991, FSHN 285 was taught as a four-day-a-week, six-week course through the College of Continuing Education and Community Service (CCECS). Five remote sites were included: UH/Hilo, Maui Community College, Leeward Community College/Oahu, Kapiolani Community College/Oahu, and Kauai Community College. This arrangement precluded using a balanced design of site and mode of delivery, as had been attempted the previous summer. Instead we took the opportunity to address a different set of research objectives. First, because CCECS requires all instructors to prepare a packet of information for the students, we were able to investigate the feasibility of using this delivery mode to distribute previously FAXed or mailed printed material for the FSHN 285 class. Second, because a non-HITS FSHN 285 was being taught the hour before the scheduled HITS class by the same instructor (DG), we were able to collect extensive data and later compare distance learners and in-class learners with respect to demographics, nutrition knowledge and nutrition-related behaviors. Furthermore, by including completion of the several questionnaires in the students "extra credit" points, we were able to collect information on individual students, rather than anonymously, as had been done previously.

Preliminary analyses of the data indicate that subtle differences exist between the total groups of students who took FSHN 285 in summer 1990 and summer 1991. For example, although there were no significant differences in age or gender distributions, the students of summer 1991 were less advanced academically and had taken fewer science courses than had the students of summer 1990. However, we have documented significant increases in nutrition knowledge in both HITS and non-HITS summer 1991 classes, as measured by a 30-question pre/post test. Current data analyses are focused on whether this knowledge change is a general one, or if certain nutrition topics are better learned than others. and if HITS or non-HITS delivery increases particular knowledge better. In addition, a 39-item eating behavior checklist, derived from the U.S. Dietary Guidelines (3), was administered to all summer 1991 FSHN 285 students. Thus, we will be able to investigate relationships between reported dietary behavior and nutrition knowledge. Furthermore, we will be able to relate these changes to appropriate demographic variables in both the HITS and non-HITS classes.

We have learned several important pieces of information from the Summer 1991 HITS class, despite the fact that enrollment in the televised class did not meet our initial expectations. First, we confirmed that it is feasible to collect a wide variety of data from a large number of students (n = 82) in a conventional classroom setting (n = 75) and from a smaller number (n = 8) in interactive television classroom settings, scattered across 5 remote sites. In addition, we discovered that using a pre-published packet of information was a less complicated and more reliable means of disseminating information to all students. It was especially more effective for the HITS students at remote sites. We have also documented that learning can be just as effective when the instructor has no students in the studio and must teach only to students at remote sites, as it is in a conventional classroom setting where the students have direct access to the instructor. Lastly, we have had the opportunity to experiment with developing supporting educational materials for presentation of identical nutrition information in two very different types of classroom setting.

6.0 THE FUTURE OF FSHN 285 ON HITS

We are planning to offer FSHN 285 again as a HITS class in Summer 1992. Our current proposal is to combine a large on-site class with several remote site classrooms, both on-O'ahu and off-O'ahu. We will continue to collect demographic information from all students, and will again administer pre- and post-tests of nutrition knowledge and food-related behaviors. In addition, we hope to create a balanced design to determine if learning is significantly effected by mode of delivery and/or mode of access to the instructor outside of regularly scheduled class time. Finally, we will be monitoring the students' classroom behaviors in order to correlate the behaviors with learning, as measured by scores on exams and assignments, as well as by reported change in dietary behaviors.

7.0 FSHN 285: BEYOND HITS

We have videotaped each lecture transmitted via HITS during the past two summers and plan to do the same for summer 1992. These videotapes have already served a number of purposes. Of course, they allow immediate feedback to the instructor with respect to correctness of lecture content and appropriateness of delivery. In addition, we now have access to a complete series of FSHN 285 lectures which we plan to update at least once each year.

Several of the FSHN 285 videos have been copied and distributed to individuals or institutions interested in the possibilities of televised interactive classroom programming. In particular, one of us (DG) is involved in an articulation process, financed in part by funds from the Agricultural Development in the American Pacific (ADAP) Project. We are currently discussing plans to develop four courses at Northern Marianas College (NMC), a community college on Saipan, CNMI, similar to courses already being taught in the FSHN department at UH-Manoa. Five of the 1990 tapes were delivered to NMC to demonstrate the technology, because the college is interested in developing an interactive television system on Saipan. Furthermore, the complete set of 1992 tapes will be later made available to the instructor at NMC who will be teaching the FSHN 285 class there. These tapes will help the instructor update her nutrition knowledge. The most recent set of tapes may eventually be used each year as supplementary material for the students at NMC when the class is being taught there.

8.0 FUTURE RESEARCH CONCERNS AND QUESTIONS

We have identified one problem that we must address more aggressively: we have had limited success in attracting large numbers of students to the FSHN 285/HITS class at the remote sites (n = 7, 1990; n = 8, 1991). Thus, we need to try new strategies for publicizing the class and for identifying if larger audiences exist and how to reach them. We believe that offering the class as a CCECS course is one solution, because one of the implicit goals of CCECS is outreach to those students who have been traditionally underserved by higher education (4). We also have begun identifying special target audiences, such as secondary health education, home economics, and science teachers, who may be interested in making their knowledge of human nutrition as current as possible (5).

The primary goal of any research that we conduct with the FSHN 285/HITS classes is to identify the combinations of informational content, delivery, and supporting materials and services that produce the most effective learning environments for the students, especially at the remote sites. In order to achieve this goal, we will continue to explore the limits of HITS in Hawai'i and to investigate appropriate and innovative uses of the televised videos throughout the American Pacific.

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Instructional Telecommunications In Alaska: Ten Years Later

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ABSTRACT

In the past 10 years, Alaska has been heavily involved in the planning and implementation of instructional telecommunication systems. Early efforts focused on developing technical infrastructure and ended abruptly in the mid-1980's with the drop in the price of oil and resulting budget reductions. While the mid/late 1980's focused on re-thinking the technical assumptions leading to early instructional system implementation, current efforts focus on more complete needs assessment prior to technical decision making.

In 1981, a focus of the PTC Conference was entitled "The Alaska Case Study" (1). The intent of the case study was to highlight the trials and tribulations that a State (by analogy, a small Country) might face when accelerating telecommunication development in a multi-cultural, climatically harsh, and sparsely populated setting.

In Alaska, 1981 was a time of great hope, anticipation, and expectation. By any standard, the state was well off with abundant oil wealth providing 85 percent of the state's income and contributing billions to its treasury. A few years earlier, Alaska had chosen to use some of its anticipated oil wealth to extend educational opportunity to all corners of the state using a sophisticated telecommunication delivery system. In the enthusiasm of the moment, however, and despite the protestations of those urging caution and planning, a series of decisions were made emphasizing equipment acquisition at the expense of a thoughtful and thorough needs assessment. The result was a technological "solution" in search of an instructional "problem," setting the stage for a 10 year cycle of expectation, frustration, and regeneration.

BACKGROUND

In the early 1970's, Alaska entered a period of experimentation utilizing the Applied Technology Satellite (ATS) system (2). The ATS-1 experiment in educational broadcasting began in 1971 with the delivery of audio and data transmission to 26 communities throughout the state. The system, using three and four meter earth stations, proved successful despite the failure of the delivery system's video capability. In fact some believe that the failure of the video component was beneficial because it encouraged users to explore the instructional uses of audio (2).

In 1975, the ATS-6 experiment began and focused on the distance delivery of video programming to 16 communities and proved that video could be delivered through small earth stations at high latitudes from a satellite in geostationary orbit.

This was Alaska's introduction to instructional television and raised rural Alaska expectations to the point that the Legislature appropriated funds for a rural television demonstration project (TVDP) in 1976. This demonstration continued through 1980 as a mix of educational services during the day and network television in the evening.

The University of Alaska's (UA) formal

involvement in instructional telecommunication for distance delivery began in February of 1979 with the establishment of a committee, charged with assessing needs and exploring distance delivery options (3). It is both interesting and ironic, however, that early in this planning document, it is evident that the decision had already been made to use satellite-based television as the primary delivery system, with audio conferencing intended to complement and provide an interactive system component. The remainder of the report dealt with management and implementation issues.

The focus on "solutions" not "problems," typified the early efforts of educational administrators in Alaska throughout the late 1970's and early 1980's and culminated in the creation of the Learn/Alaska Network (LAN), a joint UA and Department of Education (DOE) enterprise.

The LAN statewide instructional television/audio system appeared to work quite well for the first two years, although by 1983 questions started to arise concerning the instructional effectiveness of the system. Rather than slow system development and evaluate the instructional progress to date, however, all effort was put into continued system development and strengthening the technical infrastructure.

DECLINING REVENUE

By 1985 it had become increasingly apparent that the state's oil wealth was diminishing due to a decrease in the per barrel price of oil. Declining revenues resulted in close scrutiny of all state-sponsored programs, including the LAN instructional telecommunication network. Within the university alone, for example, impending budget cuts necessitated a 30 percent cut in the UA systemwide budget in the course of one fiscal year. As a result of intense scrutiny, legislative, administrative, and faculty support for the instructional telecommunication system declined. Not surprisingly, internal budget cutting resulted in various proposals for downsizing the instructional telecommunication system. This review process continued until June 1987 at which time it was announced that the LAN was being dismantled. Oversight of a vastly reduced television delivery component was reassigned to one branch of the university while an expanded audio conferencing capability was shifted to another university unit. The DOE became a system user, relinquishing management oversight.

In terms of instructional telecommunication, late 1987 through 1988 was a time of reassessment with educational administrators, legislators, and involved faculty...not to mention students, left scratching their heads, wondering what had become of a system that had appeared, at one time, to be so promising.

In retrospect, some would suggest this period of confusion, frustration, and question, not to mention the absence of technological funding, was the best thing that ever happened to instructional telecommunication in Alaska and led to an evolution in the way educational administrators view technological decision making.

Although the system budget was dramatically reduced in 1987, much equipment and infrastructure remained. More importantly, those involved in the early development of the system, as well as those watching from the sidelines, matured in their thinking as to how an instructional telecommunication system should develop. While talk of planning had always been popular, it was not until the LAN experiment concluded that administrators and faculty alike, understood that effective needs assessment planning took more than talk. It required focused action.

By the late 1980's each major UA unit had developed a distance education capability established to identify and meet the specific needs of the educational constituencies they were charged to serve. Rather than falsely assume one system could meet the needs of all learners, different approaches were used focusing on identifying specific learner needs, multi-cultural characteristics, and educational goals. These efforts resulted in various approaches to instructional

telecommunication delivery and focused on the concomitant provision of support services as instructional telecommunication systems were tested and implemented.

While, the urban center's of Anchorage, Fairbanks, and Juneau found, for example, that instructional television programming, relying on pre-packaged telecourses, could be quite effective, the rural campuses sought more individualized approaches to instruction focusing on interactive technology such as audio and computer conferencing.

At the same time, it became evident that the "rural" learner in one village might have totally different educational needs and desires from an equally rural learner living several miles away. As such, more emphasis was placed on needs assessments, village-based facilitation, and on-site visits by faculty. Increased face-to-face interaction encouraged educators to experience, first hand, the needs and realities of village life, as opposed to long distance assessments based on secondary information and questionable assumptions.

AT PRESENT...

During Spring 1991 alone, the UA offered over 190 different distance delivered courses throughout Alaska. Interactive television, for example, combining one-way video and two-way audio is being used to deliver a graduate level Masters of Public Administration curriculum to military sites statewide. The same system, relying on satellite delivery, is used to provide instruction to more traditional learners, as well as Alaska's prison system.

Initiated by the University of Alaska Anchorage and the University of Alaska Southeast, the "LiveNet" system relies heavily on cooperative programming and technical support as well as very competitive transponder rates (i.e. $100 per hour) through a local commercial carrier. In addition to the public administration curriculum, courses in education, history, geometry, literature and Native issues are being delivered to specific sites statewide.

Pre-packaged telecourses, especially popular in Alaska's more urban areas since the late 70's, continue to fill an important niche, when supported by interactive audio conferencing, facsimile, and strong print components. The University of Alaska Anchorage, for example, often delivers over 20 telecourses per semester to students throughout southcentral Alaska.

Audio conferencing remains a pivotal component of Alaska's distance education efforts. With over 250 established audio sites statewide and relying on central, regional, and remotely controlled audio bridging facilities in Anchorage, Fairbanks, Juneau, Bethel, Nome, and Kotzebue, the University of Alaska Fairbanks, alone, offers over 80 courses per semester to over 100 sites. As with "LiveNet," many of these courses use an integrated delivery approach incorporating print, facsimile, and electronic mail.

INCREASING INTERACTION

The importance of "student-student" interaction remains a critical distance delivery component. To cost effectively link class participants in 265 communities spread over 1,530,700 sq. km., an extensive electronic mail system is in place and centrally managed. And to ensure student participation, regardless of local facilities, both the UA and DOE distribute "lap top" computers with internal modems to students participating in specially designated courses.

While a major benefit of audio conferencing has long been its ease of use, relative cost effectiveness, interactive capabilities, and inherent spontaneity, a major disadvantage has been the lack of an interactive visual component to promote "teacher-student" and "student-student" manipulation of graphic images. This limitation has been especially evident in math, science, and laboratory courses. To fill this "visual gap," various experiments and pilot studies are underway utilizing different multipoint-to-multipoint interactive digital graphics (IDG) technologies such as Optel, Scanaware, and Bell Canada.

A costly disadvantage of past voice/data distribution systems in Alaska has been the need to incorporate two lines per site, one each for audio and data delivery. Recently, however, the University's computer network, through its "Alaska Telegraphics Project," has developed a single-line solution in which the IDG data stream "piggy backs" on the same phone line used for audio conferencing. This is especially significant given the patchwork of phone systems linking Alaskan communities.

Additional attention is being placed on long term distance education planning in the university as it moves towards systemwide course delivery. Towards this end, a statewide study was recently conducted to identify, prioritize, and provide alternative methods for dealing with the myriad policy and procedural issues arising from systemwide course delivery. This project, nearing completion, will be used by the university's chief academic officers to set direction and ensure that the distance delivery resources of the university are marshalled to meet specific academic needs.

Alaska's university system is not alone in its emphasis on distance education. The DOE is an active member of the grant sponsored Pacific Northwest Star School Partnership and is working with 35 school districts in Alaska in the installation and use of satellite delivered educational programs and services. By spring of 1992, 81 school sites will be equipped with the satellite and data receive equipment funded through the grant and will be utilizing the services and courses it has made possible. An additional 32 sites, investing in satellite systems prior to the grant, will make a total of 113 Alaska schools with satellite receive capabilities.

In addition, the DOE continues to produce live interactive video programs relying on satellite delivery to bring experts to students statewide. This same network is used by the DOE for overnight tapefeeds of instructional video materials.

Both the DOE and university system have found that faculty development and inservice training are critical to the long-term effectiveness of distance education efforts. Towards this end, various mentoring networks, workshops, and support services are in place to ensure that the distance delivery of instruction remains an effective and viable educational tool throughout Alaska.

SUMMARY

During the early 1980's the development of instructional telecommunication in Alaska was characterized by an emphasis on developing technical infrastructure and purchasing hardware. In contrast, the mid/late 1980's focused on review, retrenchment, and questioning of the foundational elements leading to the original technological assumptions. The late 1980's through 1991 have focused on identifying needs, establishing goals, and operationalizing the premise that instructional telecommunication requires a detailed understanding of the academic needs the technical system is designed to meet...prior to development and implementation.

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SATELLITE-ASSISTED DISTANCE LEARNING TO RURAL SECONDARY SCHOOLS: SASKATCHEWAN COMMUNICATION NETWORK (SCN)

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Abstract

Facing a declining rural population and a concurrent reduction in schools serving rural students, Saskatchewan explores curriculum augmentation using telecommunications delivery strategies in secondary schools. A pilot project is described which tests a teacher-directed classroom production model and point-to-multipoint satellite delivery of secondary courses from three originating classrooms to widely dispersed receive schools. The pilot has exposed front-line educators to the logistical and pedagogical implications of this particular method of distance delivery to secondary schools.

Introduction

"Rural Saskatchewan is mourning the disappearance of schools from villages and hamlets everywhere, says Bob Thompson, head of the province's trustees association. When the school closes it is almost like the final nail in the coffin for many communities" Marud (1991)

Closure of rural schools is only one of the many problems that plague Saskatchewan's rural communities. Dropping commodity and livestock prices coupled with rising costs in every other sector have soured the rural economy for all but the mega-farmers. A declining, aging rural population stands a lonely vigil as the young leave the family farms for the city to seek a stable income and a school for their children. The local school, curling rink, equipment dealer, and grocery store constitute the final bastion of service to the young farmer, and when the school goes so does the support structure and interest in the local community. For a decade now farm children have faced a half to a full hour bus ride to the nearest local school in order to maintain a classroom population capable of supporting a reasonable breadth of curriculum. Now these more or less centralized schools are disappearing and with them the rural town infrastructure. This phenomenon is not unique to Saskatchewan, but is characteristic of schools in the rest of rural Canada and the United States.

More than 50 rural Saskatchewan schools have closed in the past five years and now more than half of the province's 200,000 students attend urban schools. Yet this has been one of the better half-decades considering that in 1940 Saskatchewan had 5,000 schools. These numbers dwindled rapidly throughout the next 50 years. In 1950, 4,000 schools remained, declining to 2,000 in 1960, 1,008 in 1970, 927 in 1980, and 850 in 1990.

Educators, business, and the public are engaged in a life or death search for a solution to overcome the huge education and training problems facing all sectors of society. In many of the strategic plans developing in North America and elsewhere, hope is pinned on a technological situation. Rapid advance in technology has catapulted us from the industrial age to the information age in two generations, resulting in technology based systems replacing existing systems in all aspects of life outside the school. The education system, particularly the K-12 system, is one of the last institutions to succumb to technology. Strategists are staking their reputations on articulation of technological systems to be not only the cause but also the solution to the educational ills facing us.

Nowhere is the potential greater for a technological solution than in rural areas of Saskatchewan and other remote jurisdictions characterized by sparsity of population and great geographic distances. New and emerging

communications technologies have the capacity to support new modes of learning in rural as well as urban settings. Technologies of communication and learning are converging in what has been described as "digital fusion" resulting in powerful interactive multimedia learning systems that are not "place bound" as are the traditional institutions of learning. It is now apparent that a learner can receive just as effective an education in remote areas as is possible in an urban area. The people of Saskatchewan have a long tradition of providing education where it is needed. The pilot projects described in this paper provide an overview of a strategy for revitalizing the curricula for schools in rural areas.

Saskatchewan

One of ten provinces of Canada, Saskatchewan is situated between Manitoba on the east and Alberta on the west, Northwest Territories on the north and the United States on the south. Figure 1 shows Saskatchewan as it is located on the North American continent. It is an interior province sharing with Alberta the distinction of having no boundary adjoining salt water. Saskatchewan has a population of 1,000, 000 (1990) and a geographical area of 652,000 sq. km. (252, 000 sq. mi.) including 178,000 sq. km. forested land and 81,631 sq. km. of inland water. Population density is about 1.5 per sq. km. (4 per sq. mi.) and is concentrated in the southern third of the province. Climate is continental, with cold winters and hot summers. The topography ranges from semi-arid rolling plains in the south, through the central grasslands (grain belt), to rugged Canadian Shield rock, swamp and forest in the northern half of the province. Agriculture is the largest single industry with farm receipts making up $4.1 billion (1986) of a $17.4 billion (1986) g oss domestic product. Other principal industries include manufacturing, mining, meat processing, petroleum refining, fishing, forestry and electricity production.

Elementary and secondary education in Saskatchewan is carried out by a system of Protestant and Roman Catholic schools. In 1989, 863 elementary and secondary schools served 203.866 students. Post-secondary institutions include seven regional community colleges with a non-credit enrollment of 86,000 students and two universities located in the largest cities, Saskatoon and Regina, serving 20,000 students. Four technical institutes in four separate locations across the province have 7,500 full-time and 21,000 part-time students.

On the Fringe - Distance Education at the Secondary Level

Once relegated to evening hours at the kitchen table, distance education at the secondary level is poised on the brink of a quiet revolution. No longer the poor cousin at the face-to-face instructional banquet, distance education is venturing out of the shadows and into the limelight.

Distance education is not new to the secondary scene. The Saskatchewan Government Correspondence School has been in operation for over sixty years, serving up high school credits to a diverse audience of shut-ins, adult high school completers, and students in school. Over 6,000 clients a year currently access an extensive inventory of print-based, independent learning packages. What is new to distance education is the proliferation of alternative delivery systems and the multi-sensory dynamics and enhanced teacher-pupil interaction that telecommunications technologies bring to traditional correspondence study. Concurrently, there is a perceptible change in attitude among educators, motivated by a complex set of economic and demographic circumstances, toward the integration of distance education methodologies into mainstream classroom practice. The realities confronting rural school administrators today have provoked thoughtful consideration of instructional technologies to help meet the needs of their students.

Figure 1
Saskatchewan is a prairie province located in the central part of North America

For many, however, investigating the potential of distance education is like travelling in foreign territory. Obstacles of varying shapes and sizes are strewn in the path of the educator newly exploring the terrain and a tantalizing array of technological innovations transforms the landscape. As Connick (1991) suggests:

> Technology fundamentally changes the concept and possibilities of access, quality

> and productivity because it reduces or eliminates traditional barriers of time, distance, cost, limited instructional space, limited instructional and support personnel, limited learning options, differing learning styles and pace, [and] unequal student preparation. (p. 2)

A thought-provoking notion, yet perplexing in its very appeal. The question confronting educators and administrators today is just how--by what mode of transportation--does a small, rural high school increase access to a broader range of resources and cross the barriers of time, distance, and cost? From itinerant classroom teacher to politician and policy maker, the need to forge new partnerships and develop alternative strategies for the equitable distribution of educational resources challenges the boundaries drawn by geographic location and tradition. As Connick stated:

> Dealing with fundamental shifts in educational power and allocation of resources threatens the traditional and comfortable. (p. 3)

No one technology; no one mode of delivery is a panacea. Volkswagons, Cadillacs, and Jeeps travel our highways achieving the same fundamental purpose, albeit in a myriad of designs appropriate to the driver's needs and budget. Distance education offers a similar proliferation of vehicles, from computer-assisted instruction, to audio and video teleconferencing, audiographics, electronic bulletin boards, and more. The technology exists. Barker, Frisbie, and Patrick (1989) conclude:

> The desired end result in distance education has been to provide an educational opportunity equal to that provided in traditional classroom teaching. A major factor in the growing interest in distance education is the ability to conduct live, real-time instruction between teacher and student(s) made possible by technology. This ability to simulate, as close as possible, a traditional classroom teaching/learning experience permitting live teacher/student exchanges and student/student exchanges--irrespective of geographical distance--is changing the scope and definition of distance education. (p. 22)

The authors suggest that the significant advantage of what they call "telecommunicated distance education" is the capacity to electronically bridge the geographic distance between small groups of students. They continue:

> Telecommunicated distance education projects are not focused on an individualized instructional model as is the case with correspondence-based distance education. Instead, the focus is on small groups or clusters of students at different locations networked together for real-time audio interaction with the instructor and with each other...The prospect of student-to-student exchanges not only increases the likelihood of socialization between students but also fosters the potential for peer tutoring and small group study. (p. 24)

Distance education in many high schools is still reserved for the kitchen table or, at best, a fortuitous gap in a student's time table. The student, ill-equipped for independent study and isolated in the experience, is in danger of becoming yet another statistic in the ranks of attrition. Communities cling tenaciously to tradition: a teacher planted firmly in front of a classroom of students, dispensing knowledge. Reality echoes with the footsteps of too few students to support the system. Teachers, threatened by technology, retrench and resist. Administrators struggle to maintain the status quo.

Despite the obstacles, the quiet revolution has begun. While the collective vision and the monetary muscle to move distance education from the isolated fringe to mainstream education has not yet fully emerged, the early adopters of change are at work.

> It is time to build the virtual classroom that provides the familiar interactivity between the learners and their teachers but without the constraints of physical reality. Distance education will bring knowledge to the learner, wherever he or she may be, whenever he or she can engage it. Technology will provide the means; innovative, proactive educators will provide the impetus. (Lever, 1991, p. 15)

Setting the Stage for Mainstream Distance Education

Saskatchewan has its innovative, proactive educators who are hungry for the knowledge, tools, and experience with which to operationalize the principles of distance education. The post-secondary sector in the province has, over the past decade, delved extensively into the ways and means of utilizing telecommunications technologies to reach beyond institutional walls. The University of Saskatchewan led the way during the early 1980's with trials in satellite-assisted delivery of credit courses. Early experiments spawned the formation of the Saskatchewan Tele-learning Association (STELLA), a consortium of institutions banding together to increase access to learning opportunities for place-bound learners. STELLA and its pioneering programmers forged the way for the implementation of a full-scale provincial satellite and fibre optic network known as the Saskatchewan Communications Network (SCN).

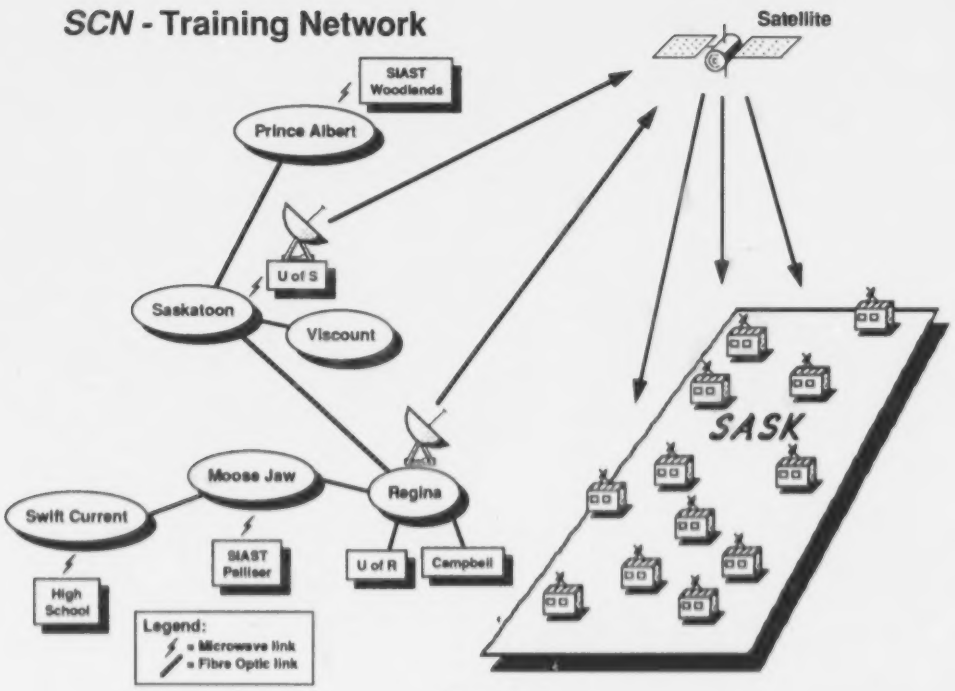

Figure 2

Saskatchewan Communications Network (SCN) provincial training network configuration

The evolution of SCN and its forerunner, STELLA, is described in the following papers: Brown, 1990a, and Brown, 1990b.

SCN comprises two distinct networks: the SCN Cable Network, an educational television channel distributed to cable subscribers, and the SCN Training Network, a narrowcast network dedicated to distance education and training. The Training Network's primary mode of delivery is a one-way video and two-way audio configuration. In cooperation with the province's Regional Colleges and post-secondary institutions, the Training Network transmits credit courses to 54 centres across the province. See Figure 2. During the 1990-91 academic year, 1,100 hours of instruction were delivered to almost 2,000 students. Network volume and student access continues to grow.

Telecommunicated Distance Education Enters the Secondary Arena

Experimental activities are beginning to percolate within the secondary sector. The innovators are acquiring a knowledge base through hands-on experience. Educators are critically assessing the pedagogical practices and instructional strategies that must shape and direct technical interventions. In 1989, the Eastend School Division began to gain recognition for an imaginative and aggressive approach to equitable access to resources. Outfitted with satellite receive hardware, the division's four high schools participated in early trials of "video on demand" technology, the precursor to Super-Man, the Switched Urban Programming for Educational Resources - Metropolitan Area Network project launched by Graham Bradley, Director of Research and Development, Saskatchewan Telecommunications. For a full description of the "forward and store" information delivery concept of Super-Man technology, see Brown and Oliver, 1990.

The second project that the Eastend School Division initiated was a small group, individualized distance learning project managed by facilitating teachers working in close collaboration with subject matter experts from the Correspondence School. The model shows promise. The team teaching approach bodes well for student success. Managing the group process and each student's progress requires a unique set of classroom management skills. Of equal importance is the investiture of independent study skills in students unaccustomed to managing their own learning. Gary Luke, Director of Eastend School Division, writes:

> We were not long in developing a policy of roles, expectations and structures to be employed in distance learning classrooms in the Eastend School Division. We have adopted a team teaching approach. The teacher in the classroom is responsible for the student's success. The teacher in the

classroom is teamed with other teachers miles away who have expertise in the subject areas chosen by students. There is a definite structure; a time when assignments are turned in as in a regular classroom; a time for instruction, although over the phone; a time for group discussion, a time to formulate questions; and regular quizzes and tests, as in a regular classroom. The only difference is that there are more people with expertise available to the student and a variety of subjects are being handled in the same class period--and the students are becoming somewhat technologically literate. (excerpt from personal speaking notes)

While students strengthen independent learning abilities and maintain group affiliation needs, the telephone and facsimile provide the vital link with experts at a distance. The facilitating teacher contextualizes and directs pedagogical practice. Luke concludes that the team teaching approach to "small groups of similar abilities" has been a successful method of implementing and enhancing distance education practice.

The Eston-Elrose School Division is experimenting with another mode of delivery: two-way video and audio using compressed video technology to link teachers and students in two high schools within the school division. Each classroom is outfitted with a television camera, microphones, and a key pad device which controls camera movement. A teacher located in Kyle teaches Geometry/Trigonometry to a class in Elrose and a reciprocal course in Calculus originates from Elrose. One of the primary objectives of the point-to-point delivery mode is to facilitate the efficient distribution of teaching expertise within the school unit, utilizing human resources among the four high schools to accommodate small group needs through distance learning. The project is in its first semester of operation and, according to school administrators, shows promise in fulfilling long-term teacher resourcing goals.

The balance of this paper will discuss a major pilot project that was launched by the Saskatchewan Communications Network and the Saskatchewan Government Correspondence School during the 1990-91 school year. It was a pilot that would test a teacher-directed classroom production model and point-to-multipoint satellite delivery of secondary courses from three originating classrooms to widely dispersed receive schools.

Interactive Televised Instruction - A Pilot Project

Denise, a Grade Eleven Algebra student, is stuck on an equation. She's asked her teacher, Mr. McLeod, for help. "Let me have a look at your assignment, Denise." He's able to spot her problem immediately and show her where she's gone wrong. A few minutes later, he discusses the same problem with the entire class.

This scene takes place daily in schools across the country; the difference with this one is that Denise and Mr. McLeod are over 300 kilometres apart. They discussed the problem by telephone and Denise's assignment travelled back and forth between their facsimile machines. When Mr. McLeod presented the problem to the class, some of his students were seated in front of him while the rest of his class watched him on their television monitors. Telecommunications technology brought them all together.

The pilot project was designed to transmit live, interactive instruction via satellite using a one-way video, two-way audio system configuration. During the first semester of the pilot, courses originated from production classrooms at Campbell Collegiate in Regina, Swift Current Comprehensive High School in Swift Current, and Viscount Central School in Viscount. Classes were transmitted via satellite to schools in La Loche, Sandy Bay, Plenty, Oungre, Rabbit Lake, Burstall, Bateman, and Kinistino. The distance from Oungre in the south of the province to the predominantly native community of LaLoche in the north is approximately 850 kilometres or 528 miles--Oungre is situated just north of the 49th parallel and LaLoche at the 57th parallel--a distance representing not only geographic separation but diverse cultural and regional differences as well.

Instructional Configuration

The Correspondence School affixed the acronym ITI to the project--Interactive Televised Instruction--intended to reflect not only the principal mode of delivery but the capacity for real-time, teacher-pupil interaction. With funding assistance from SCN, the Correspondence School undertook the complex task of managing the instructional components of the project. A comprehensive set of objectives was outlined, including the following:

- reinforce, explain, illustrate, and expand upon print materials
- develop a teaching tool to disseminate information, elicit action or reaction, and utilize critical and creative thinking and problem solving skills
- accommodate a wider variety of learning styles (visual and auditory)
- promote interactive and resource-based learning by providing motivation, background information and direction for follow-up activities
- consciously incorporate instructional strategies that would promote development of common essential learnings and gender equity
- accommodate large groups at a few different places, or small groups, even

individuals, at various sites throughout the province
* improve cross-cultural understanding and appreciation
* increase student appreciation of technology as a medium for learning
* foster the image of the Correspondence School as an up-to-date, viable, learning institution. (Eger, 1990)

The Correspondence School solicited applications from potential receive schools. In order to participate in the pilot, schools were required to install the appropriate hardware to receive the signal, incorporate Correspondence School policy guidelines, provide a facilitating teacher, attend planning sessions, and pay tuition fees on behalf of their students. In addition to coordinating the receive schools, the Correspondence School, in consultation with the production schools and receive sites, selected the courses for delivery, provided instructional design and team teaching support, set and marked exams, and conducted formative and summative evaluations of the pilot.

Three courses were chosen for first semester delivery: Algebra, French, and Accounting. Geometry/Trigonometry, French, and Biology were chosen for the second semester. In each course, the production school's tele-teacher taught his or her own on-site class in conjunction with live, interactive sessions with remote classes. Students at a distance viewed the teacher on a television monitor and could call in by telephone to ask questions and respond to the teacher. Homework problems, assignments, and quizzes travelled between the teacher and students by facsimile machine. The facilitating teacher at each receive site managed the group process and guided students in their studies, as well as maintained the instructional liaisons with the tele-teacher and Correspondence School support staff. The Correspondence School's independent study packages provided the curriculum and print support.

Technical Configuration

The delivery system required the establishment of a one-way video, two-way audio teleconferencing and facsimile network originating from the three production classrooms in Swift Current, Viscount, and Regina. Each classroom was equipped with a portable studio production kit enabling teachers to deliver live, interactive instruction to receiving schools. The production kit, designed by Jim Sax of Video One Systems Ltd in Saskatoon, contained three single-chip cameras, a six-video input switcher, a three-channel wireless receiver with three high band VHF wireless microphones, a standard industrial video cassette recorder, a frame synchronizing time base corrector with standard broadcast video level output, and an 11" colour monitor. The hardware configuration was built into a custom-designed aluminum shell casing.

The hardware configuration was designed to be teacher operated. A general objective of the pilot was to test the feasibility of a low-end production system--a system requiring minimal cost and production expertise and a minimum of obtrusive hardware and personnel. Randy McLeod, tele-teacher from Campbell Collegiate, assisted by Dave Zimmer of Saskatchewan Telecommunications' Research and Development department, began to explore ways of improving the hardware configuration. The most innovative enhancement was the addition of a remote controlled, infra-red switcher which replaced the original push-button switcher. This enabled the teacher to remote control camera selection from anywhere in the classroom, negating the need to rely on an assistant or to return physically to the control panel each time a different camera shot was required. An Elmo Visual Presenter was a further important addition to the configuration to improve graphics and overhead transparency transmission, as well as display student assignments and working diagrams. Other enhancements included a second display monitor, an additional video cassette recorder to enable both record and play-back, and a fourth camera.

A combination of fibre optic and microwave links were established to transmit signals from the production classrooms to satellite uplinks in Regina and Saskatoon. SCN offered school boards affordable hardware lease option packages to outfit individual receive sites with Ku-band satellite receiving equipment and to provide on-going maintenance and technical support.

Technical Evaluation

An interim technical evaluation during the first semester of delivery revealed three problem areas: audio configuration, unexpected down time, and training. A weakness in the audio configuration at the production sites was problematic. Hand-held microphones for student responses proved inadequate. Students were reluctant to use them and in-class responses were frequently missed by distant viewers. Audio levels were also inconsistent. VU meters were added to each production kit to ensure accurate on-site monitoring and adjustment of audio levels. An enhanced audio configuration is being tested in which ceiling mounted microphones are positioned to pick up student responses.

While some down time occurred due to problems with encoder/decoder devices in the fibre optic/microwave links, the majority of down time occurred as a result of inadequate communication and scheduling procedures and policies. While well established and fully

operational procedures were in place for post-secondary network delivery, new procedures had to be implemented for the secondary sector. Down time occurred, on occasion, as these procedures were implemented and adapted.

As has been demonstrated in the delivery of post-secondary courses, one of the most important support services continues to be the provision of training for individuals at receiving sites. In many instances, satellite receivers were installed just prior to course delivery. This resulted in insufficient time for people on site to become completely conversant with the equipment or for SCN to train personnel. As individuals became more adept with the hardware and gained experience in tuning to the correct satellite transponder and audio sub-carrier, operator errors decreased.

Instructional Evaluation

A comprehensive survey of pilot project participants was conducted by the Correspondence School upon completion of the first year of the project. The pilot tested the mettle of all involved as students, teachers, administrators, and technicians grappled with the technical and instructional implementation of the project. While the frustrations of start-up technical, administrative, and communication problems were evident in the survey, the role of the teacher was clearly the focus. The tele-teacher's role is perceived as multi-faceted and a critical success factor.

> The instructor is the key to success. The process can be intimidating. The instructor must have the confidence and will to control the situation and not have the situation control the individual. (SGCS Survey)

Calvert (1986) concluded that "...the introduction of any form of mediating technology requires an instructor to learn new skills to use the technology and compensate for missing cues" (p. 101). Instructional style and immediacy behaviours appear to have a direct bearing on student perceptions of a televised mode of delivery. (Hackman and Walker, 1990) Anecdotal comments in response to the Correspondence School survey addressed the role of the tele-teacher in the areas of motivational tactics, immediacy skills, pacing, and interaction.

Participants saw the tele-teacher's role as motivational, one which provided the spark or incentive for students to work and progress. Motivation appeared to be closely related to performance and interpersonal skills: "Make the broadcast more fun." Participants wanted teachers' television presentations to be exciting, dynamic, and interesting. The teacher requires "the ability to personalize the delivery" and is expected to "promote student participation and interaction." The teacher was also seen as a pacing mechanism, a means of keeping students on track and a means of reducing the isolation of the distance learning experience. Clearly, the teacher who teaches on television must possess a number of attributes which can readily be communicated through the eye of the camera.

Conclusion

The pilot project has afforded a learning experience for all involved. Technically, this mode of delivery is eminently feasible. The foundation of a network infrastructure comparable to that of the post-secondary sector has been implemented. The pilot has exposed front-line educators to the logistical and pedagogical implications of this particular method of distance delivery. Much has been gained; much more can be learned. As teachers acquire the requisite skills and experience, instruction will improve. As students develop a repertoire of independent study skills, learning will improve. As distance education becomes an integral part of the classroom experience, in whatever mode it most appropriately manifests itself, greater equity of access will be achieved.

A parent responding to the Correspondence School survey said it this way:

> I have dreamed for years of a system such as this being available in Saskatchewan, enabling any student in any school large or small to have the opportunity to take any subject offered.

That is the dream. We have the capacity to make the dream a reality.

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Experimental International Language Teaching Between Japan and Australia Using 64/128 kbs Compressed Video via ISDN

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1. ABSTRACT

Language teaching between Japan and Australia using 64/128 kbs videoconferencing via international ISDN has been successfully undertaken. The trials took place in March 1991. The parties involved in the experiment were the National Institute of Multimedia Education, the University of the Air, the University of New England, Sony Corporation and Telecom Australia.

2. INTRODUCTION

In past few years, a videoconferencing system using compressed video technology with a low bit rate of 64 kbs or 128 kbs has been developed. The significance of this low speed is that it is adaptable to the basic rate interface services of ISDN. It has been developed to the stage that it is possible now to use it for interaction throughout the world.
The low bit rate videoconferencing system is increasing in popularity because of its complete interactivity in voice and picture at the highest cost efficiency, that of the cost of a standard phone call. The system was in great demand during the recent Persian Gulf War. From an educational aspect, this videoconferencing system was thought to have the potential to assist two-way teaching at a distance.

In 1988, the National Institute of Multimedia Education,Japan started to examine the educational use of the system with "INVITE 64" via NTT's ISDN services of INS-NET64, in co-operation with KDD, VIDEOCOM International Incorp. together with the University of the Air, Japan(1). As a result, it was thought that the low bit rate videoconferencing system may have an application in interactive teaching at a distance. It was particularly thought to be useful in small sized classroom teaching,group intervieving, seminar, or learning guidance. Problems were obvious in the quality of voice and motion picture but it was thought these could be improved by technologically and pedagogically development. This experiment took the initiative in world educational use of the low bit rate videoconferencing system.

The University of New England in NSW recently become one of the first Australian tertiary education institutions to install a videoconferencing system. Having already undertaken trials earlier in the use of video point-to-point links via Telecom's Iterra satellite system, the UNE commissioned Telecom to establish a trial demonstration of a 2 mbs and 384 kbs videoconferencing link in October 1989. Although participating students reported little quality difference between the two speeds, the cost difference was substantial. So, under a three year contract, Telecom was commissioned to install the 384 kbs ISDN based videoconferencing system beginning 1990. The system's core was Telecom's CLI Rembrant II/06 codec, along with a Summit system 2000 multiplexer, and a Jtec Macrospan. The system has been used currently for about 2~3 hours pere day for administrative purposes and some teaching. Inter-campus lectures have been conducted, and overseas links have been established(2).

By 1991 rapid progress of compression technology, led to new versions of low transmission rate videoconferencing system. This included a version of an acceptable picture quality at 56 kbs which has become available at a much lover price than earlier. The circumstance led us to establish trials in both Japan and Australia. The objectives of the 1991 experiment were to evaluate the acceptability of the latest 64/128 kbs videoconferencing system for Japanese and Australian distance education,as well as to determine whether Australia and Japan had the potential to assist foreign language teaching in the other country.

3. EXPERIMENTAL

The trials took place in early March 1991.

The parties involved in the experiment were the National Institute of Multimedia Education, the University of the Air, the University of New England, Sony Corporation and Telecom Australia.

3.1 SYSTEM

Tokyo site: Videoconferencing room, Sony Corp.Minatoku, Tokyo which had installed the Sony videoconferencing system including
PCS-L2000(CLI Rembrandt)codec
RCS-S1100 system controller
VID-P10 presentation apparatus

963

Armidale site: Distance Education Centre, the University of New England which had installed

- Telecom's CLI Rembrandt II/06 codec
- Summit System 2000 multiplexer
- Jtec Macrospan
- AC 1200 echo cancellor
- Dataplex modem

Each of the sites also had video equipment including a 27 inch colour monitor and a 14 inch self view colour monitor from Sony; a Sony Miller fluidmount camera; an Elmo visual presenter(Armidale only); a Sony video recorder; and an Audio Text omnidirectional microphone(Armidale only).

3.2 STUDENTS PARTICIPATION

Tokyo site: fourteen students of the University of the Air
Armidale site: sixteen students of New England Girls's School

3.3 TEACHER PARTICIPATION

Japanese language from Tokyo to Armidale: Assoc. Prof. Masako Hiraga and Assoc. Prof. Yoko Fujii of the University of the Air
English language from Armidale to Tokyo: Mr. Graham Patterson and Mrs. Ruth Nicholls of the University of New England

3.4 COORDINATION

Tokyo site: Prof. Shigeru Wakamatsu and Visiting Assoc. Prof. Geoff Arger of the National Institute of Multimedia Education
Armidale site: Mr. Stan Tonkins of Telecom seconded to the University of New England

3.5 SYSTEM ORGANIZATION

Tokyo site: Mr. Ryuji Kitada of Sony Corporation
Armidale site: Mr. Stan Tonkins of Australian Telecom

3.6 SESSION SCHEDULE

The first week was at 64 kbs and the second week at 128 kbs. There were three separate sessions at the same speed to give the evaluation credibility. Each group contained eight students.

- The first week: March 3,4,5, 1991
- The second week: March 11,14,15, 1991

3.7 PROGRAM

11:00~11:30 English language session from Armidale to Tokyo
11:30~11:45 Completion of the evaluation sheet
11:45~12:15 Japanese language session from Tokyo to Armidale
12:15~12:30 Completion of the evaluation sheet

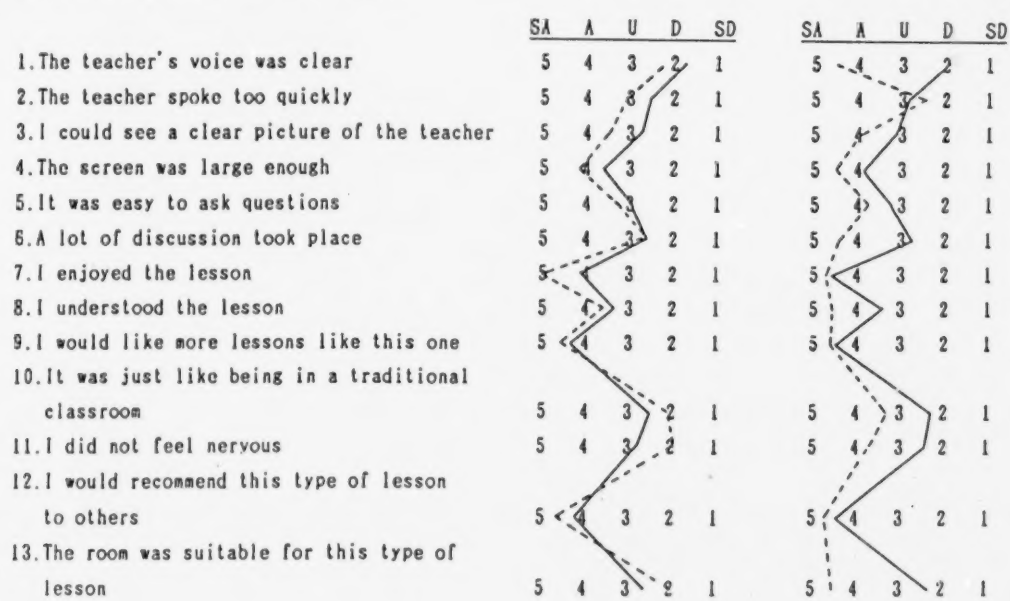
Both sessions were often prolonged to around forty five minutes by exited interaction between teacher and student.

Figure 1

1st week(64kbs) ———
2nd week(128kbs) ------

Figure 2

Japanese ———
Australian ------


SA A U D SD
1.The teacher's voice was clear
2.The teacher spoke too quickly
3.I could see a clear picture of the teacher
4.The screen was large enough
5.It was easy to ask questions
6.A lot of discussion took place
7.I enjoyed the lesson
8.I understood the lesson
9.I would like more lessons like this one
10.It was just like being in a traditional classroom
11.I did not feel nervous
12.I would recommend this type of lesson to others
13.The room was suitable for this type of lesson

Strongly Agree (SA)=5; Agree (A)=4; Uncertain (U)=3;
Disagree (D)=2; Strngly Disagree (SD)=1

4. EVALUATION

4.1 STUDENTS'S RESPONSES TO THE EVALUATION STATEMENTS

The evaluation was organised using the same instrument initially developed by UNE. Japanese students's mean scores of the evaluation statements throughout the three sessions each is presented by Figure 1. Figure 2 shows the overall comparison between the mean scores of the responses of Australian and Japanese students to the evaluation statements throughout six sessions of 64/128 kbs.

4.2 STUDENTS'S RESPONSES TO THE OPEN ENDED QUESTIONS

(1) What were the good things about this lesson?

Japanese students liked being able to learn directly from foreign teacher (78%,week 2). Australian students comments were extremely positive. It is clear that this small group of students enjoyed the experience of being involved in the teaching trial. Perhaps the following comment summarises the feelings of the Australian students.

"I really like being taught from Japan. It was good fun and I think if there was more teaching like this foreign languages would be easier to learn."

(2) What could be changed to improve this lesson?

Japanese students:

a) The teacher's voice could have been more clear(week 1, 74%; week 2, 52%).
b) Would have preferred to speak without hand microphone(week 2, 21%).
c) Picture could have been more clear (week1, 17%; week 2, 12%).
d) Delay of audio could be reduced(week 1, 9%; week 2, 16%).

Australian students:

There were only two aspects of the teaching trial that several students felt could be improved. These were the seating and a greater confidence about being involved in discussion. Some students said the chairs were a bit uncomfortable and that "it is easier to concentrate when you feel comfortable". Although the Australian students indicated there was a reasonable amount of discussion, some indicated that they wanted to say things but felt uncertain as to whether they could really speak out freely.

(3) Do you think lessons like this one are valuable in foreign language teaching?

Japanese students:

Most of students said "Yes, they are valuable"(week 1, 58%; week 2, 94%).

Australian students:

The students indicated that the lessons were both valuable and enjoyable. A comment from one of the open-ended responses indicates the nature of student views. "I think we have all enjoyed these lessons.You can certainly learn a foreign language from thousands of miles away if you have this sort of television".

4.3 TEACHERS'S RESPONSES

Responses by Japanese teachers to the open ended questions were as follows.

(1) What were the good things about this lesson?

Teacher A: The layout of camera, monitor, etc. was good easy to manage. "Show & tell worked well as always.

(2) What could be changed to improve this lesson?

Teacher B: The voice quality. I heard echo very often. The time lag of the sound also could be improved.

(3) Is this type of instruction particularly suited to foreign language teaching?

Teacher A: I think it is suited more to lecture type than to interactive type of instruction. It does give students a sense of "performance" and good motivation.
Teacher B: Not particularly. Especially I don't think this type of instruction is suited to drill type of language teaching.

(4) What other subject areas is this type of instruction suited to?

Teacher A: As stated above, it is suited to lectures.
Teacher B: It is suited to cultural or anthropological subjects, international communication, cultural introductions and so on.

(5) Any other comments?

Teacher A: The three TV sessions have created a nice feeling of sharing between the students and me, which might have been difficult by postal correspondence.
Teacher B: I noticed that the participants, including the teacher shoud realize that they have to wait for the time delay after they spoke and that it is very hard to have a quick question and answer type of conversation.

5. CONCLUSION

The worlds first international video lesson using ISDN was very successful. There are a number of general observations that can be made regarding the data collected during the Tokyo-Armidale video conference link. However it seems appropriate to point out that only a small number of students were involved in the teaching trial and that the novelty of the link may have influenced the perceptions of participants. The statistical tests carried out on the data should be considered as indicative of trends, rather than conclusive outcomes.

5.1 RATING SCALE RESULTS

The following points can be made regarding the overall comparison between the responses of Australian and Japanese students.

(1) The Australian students tended to rate the items more highly than Japanese students. AS a consequence of this, there were a number of significant differences in the mean scores.

(2) Based on the mean scores, both groups of students rated the same three items most positively. These items were "I would like more lessons like this", "I enjoyed the lesson" and "I would recommend these lessons to others".

(3) The responses of Japanese students tend to indicate they did not find the teacher's voice particularly clear, the room they were in was not particularly suitable and they did not believe the instructional experience was like being in a traditional classroom.

(4) Both groups of students tended to the week 2 experience more positively than week 1. This was more marked in the Australian data.

5.2 RESPONSES TO THE OPEN ENDED QUESTIONS

Finally, responses to the open ended questions by students of both countries were quite positive. This teaching technique should create a sense of closeness by the interaction between teacher and students, nevertheless there is an inevitable "delay of sound" caused by satellite transmission connecting the two countries.

Additionally, a further pedagogical examination should be conducted regarding this technique particularly on its application to lecture type of instruction as well as to the interactive type.

ACKNOWLEDGEMENT

The authors wish to thank Assoc. Prof. Masako Hiraga and Assoc. Prof. Yoko Fujii of The University of the Air, Mr. Stan Tonkins, Mrs. Ruth Nichols, Mr. Graham Patterson of The University of New England, together with Mrs. Kumi Fujimori of The New England Girls' School for their eager cooperation.
The authors also deeply appreciate Mr. Ryuji Kitada and Mr. Yoshihiko Kawakami of Sony Corporation's helpful collaboration.

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Pacific Telecommunications Council
2454 South Beretania Street, Suite 302
Honolulu, Hawaii 96826 USA

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Pacific Telecommunications Council Fourteenth Annual Conference

973

January 12–15, 1992
Sheraton Waikiki Hotel ▼ Honolulu, Hawaii

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SATELLITE PROGRAM DISTRIBUTION IN THE PACIFIC

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ABSTRACT

Recent domestic and regional satellite systems in the Pacific region have created opportunities for dramatic growth of cable programming. Proposals for additional satellite capacity hold the promise of much greater opportunities for programmers. The ability of programmers to exploit these newly created opportunities, however, will depend on the development of terrestrial policies designed to permit expanded use of satellites.

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SATELLITE PROGRAM DISTRIBUTION IN THE PACIFIC

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In the United States, it is generally accepted that the use of satellites for distribution of video programming was the key element in the growth and development of cable television systems. Cable News Network, Home Box Office, Turner Network Television and a host of other programming sources owe their success, in large part, to satellite distribution. It is natural, therefore, for successful programming companies to seek to expand their markets into the Pacific region using satellite distribution.

Until recently, a lack of satellite facilities, high prices for transponder capacity and the need to use relatively large receiving antennas has hindered the development of distribution channels along the lines of these domestic United States ventures. In this paper, we will explore the recent growth in the sources of existing and planned satellite capacity, the impact this has already had on the growth of cable programming outlets and some of the remaining obstacles which must be overcome before we will see a robust market for cable programming.

I. Existing Satellite Capacity

Traditionally, there have been three sources for satellite capacity in the Pacific: INTELSAT, Indonesia's regional PALAPA satellite system and Australia's AUSSAT. Although INTELSAT operates 4 satellites in the Pacific region, the high cost of INTELSAT circuits and the need to use relatively large receiving antennas, has limited

the incentives for cable programmers to exploit this capacity for distribution. CNN has been a notable exception to this rule, using INTELSAT space segment to broadcast its programming to the Pacific market for the past four years. The PALAPA system's two satellites have 24 C-band transponders and have provided Indonesian and regional service on a limited basis, but, until recently, had failed to attract significant attention due to the need to use relatively large and expensive receiving antennas. AUSSAT's satellites have provided extensive television coverage but are limited to Australia and New Zealand.

The recent introduction of new satellite capacity in the Western Pacific has dramatically changed the picture for cable programmers. The launch of the Japanese direct broadcast satellites and the AsiaSat 1 satellite focused attention on the demand for sophisticated and diverse programming throughout East Asia and the Pacific. Although the failure of the Superbird satellites was a

significant set back for the Japanese direct broadcast satellite industry, Japan Communications Satellite Co. (JCSat) has successfully introduced services on its two JCSats. The JCSats provide 32 Ku-band transponders covering the main Japanese islands. Located at 150°E. and 154°E., these satellites have been operating at full capacity due to additional traffic picked-up after the 1990 in-orbit failure of Superbird A. Space Communications Corp., owner of the Superbird satellites, plans to launch two replacements in 1992 which will introduce additional capacity for broadcasting.

The launch of AsiaSat 1 in 1991 has had an even more dramatic impact on public perception of satellite distribution of programming. AsiaSat 1's two beams cover China and East Asia stretching west to Pakistan and the Middle East. Up to 12 of the 24 C-band transponders on the satellite are available for Hutchison Whampoa's HutchVision STAR TV regional television service. STAR TV

commenced service in August 1991 with its twenty-four hour a day Prime Sports channel. STAR TV added MTV Asia in September and a Mandarin Chinese-language channel in October. Most recently, STAR TV added a twenty-four hour a day English language news program in conjunction with the BBC. The introduction of these new programming sources, has sparked renewed interest in the traditional sources of satellite capacity as well. Indonesia's PALAPA B2P satellite has recently been chosen for distribution of ESPN, and CNN has moved to PALAPA from INTELSAT. Most recently, PALAPA announced an arrangement with Hong Kong-based Business News Network for broadcast of an all business and financial news station. With its coverage of Southeast Asia, parts of China, the Philippines and Indonesia, the PALAPA satellite provides a significant complement to the service provided via AsiaSat 1.

II. PROPOSED SATELLITE SYSTEMS

The successful implementation of even a small number of the proposed satellite systems for domestic, regional and international service in the Pacific and East Asia will create even more incentives for cable programming distribution in this region. The announced proposals include the following:

- Unicom Satellite Corp.

  Unicom has two separate proposals for entering the satellite market in the Pacific. Under the first scenario, Unicom will operate two satellites in orbital positions assigned to the Republic of Tonga's Tongasat system. Unicom has proposed a 1994 launch of the first of these satellites for Pacific and international service. A second satellite for domestic and regional service in Asia is proposed for 1995. Each satellite will carry 12 C-band 36 MHz

transponders capable of servicing 3 meter antennas and 6 Ku-band 72 MHz transponders operated as 12 36 MHz transponders capable of servicing 1.8 meter antennas.

Unicom has also applied to the Federal Communications Commission for authorization to assume McCaw Space Technologies, Inc.'s conditional authority for a U.S. authorized separate international satellite system serving the Pacific and Indian Ocean regions. Unicom proposes to convert McCaw's authorization for two satellites over the Pacific and Indian Oceans into two paired "lightsats" at 170° E. and 70° E.

- PanAmSat

  The Federal Communications Commission has granted PanAmSat's application for its fourth

satellite, PAS IV, to be located at 192° W. PanAmSat plans to launch the hybrid satellite in the second quarter of 1994. With up to 48 transponders proposed, some at high power, this satellite will offer trans-Pacific service to small receiving antennas. PanAmSat also plans to launch a second Pacific region satellite, PAS V, for operation at 194°W.

- South Korean Domsats

  The government of South Korea has recently entered into a contract for construction of two satellites which will comprise the country's first domestic satellite system. Each satellite will contain 12 Ku-band, 12-watt transponders for domestic communications and 3 120-watt transponders for direct broadcast television service.

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- THAISAT

  Thailand has proposed to launch its first domestic satellites in 1993. Each of the two initial satellites will carry ten C-band transponders and two Ku-band transponders.

- MEASAT

  Bina Riang Pte. Ltd. of Malaysia has announced a 1994 launch date for the Malaysian East Asia Satellites. The MEASAT system will be composed of two satellites based on the same design adopted for THAISAT.

- PacStar

  PacStar, a regional satellite system proposed by Pacific Satellite, Inc., is scheduled for launch in late 1993. The first two planned

satellites each will include a yet to be determined number of C- and Ku-band transponders, with EIRP levels higher than INTELSAT, AsiaSat, and PALAPA. PacStar plans to provide service to the east and west rim of the Pacific basin and the south Pacific islands. High power spot exams would provide service to the more populous South Pacific islands and Papua New Guinea.

- Columbia Communications

  Columbia Communications has the right to use the C-band capacity (12 36MHz transponders) on NASA's Tracking and Data Relay Service Satellite (TDRSS) located at 174°W. Although it provides only limited capacity, the TDRSS paired downlinks can provide coverage to Northeast Asia and the Northwestern United States.

- AUSSAT and Telecom/OTC

  With the restructuring of the Australian telecommunications entities, it is unclear what role satellites will play in the future for Australia and New Zealand. The launch of the AUSSAT "b" series in 1992 will offer new satellite capacity. It remains to be seen what path will be followed, however, as AUSSAT's new owner, Optus Communications, redirects the company's efforts towards broad-based competition with Telecom/OTC. Similarly, the desire of Telecom/OTC to enter the satellite business is unknown at this time.

Although there are a number of proposed satellite systems that have been announced, it remains unclear whether video distribution will be a major source of business for these satellites. The experience in the United States has

demonstrated that the growth of domestic systems has encouraged video distribution, particularly because satellites are an extremely efficient vehicle for multipoint delivery. Moreover, because video signals use significant amounts of transponder capacity, video distributors should be attractive customers for these systems. In conjunction with this discussion of satellite capacity, outline below are terrestrial issues which may become more important to broadcasters as distribution systems in the Pacific region develop.

III. TERRESTRIAL CONSIDERATIONS

With the growth of distribution options, programmers will need, more than ever, to address the terrestrial barriers to distribution which still exist. Traditionally, many Asian and Pacific countries have sought, for either political or social reasons, to restrict the distribution of information. The introduction of

satellite-based broadcasting has already challenged these attempts but has given some governments renewed determination to continue terrestrial restrictions on programming.

The need to coordinate terrestrial and satellite policies was illustrated by recent controversies in Japan and South Korea. The introduction of satellite broadcasting for Japan has troubled South Korea which received spill-over signals. Charging Japan with cultural imperialism, South Korea has pressured the Japanese broadcasters to modify the satellite footprint to reduce the strength of the signal received in South Korea. Similarly, Japan has objected to the reception throughout the Japanese islands of BBC programming from AsiaSat 1. The introduction of new domestic and regional satellite systems will tend to increase these claims as countries struggle to retain their cultural and social independence in light of the increasing internationalization of the distribution of information.

Various approaches have been adopted to prevent unwanted reception of satellite signals. Malaysia, for example, has renewed its ban on TV Receive Only (TVRO) antennas. Japan continues to restrict small DBS receive antennas. However, the introduction of smaller antennas and higher-powered satellite signals reduces the effectiveness of these efforts to restrict reception and make it more likely that an increasing number of illegal receive antennas will become available in these countries.

Even if distributors overcome these social and political problems, financial barriers to distribution may present more formidable challenges for broadcasters. Lack of compatibility between satellite systems has already resulted in an inability to receive multiple satellite signals. For example, to receive both AsiaSat and JCSAT programming, a subscriber would need separate antennas and tuners. The additional cost of equipment, when combined with subscription fees, may place most programming beyond the reach of viewers.

Similar concerns are raised by the issue of signal scrambling. Failure to scramble the AsiaSat signal has created a disincentive for programmers to broadcast using this satellite. Yet, introduction of incompatible scrambling systems may exacerbate the already confusing pattern of broadcasting. The introduction of new satellite systems can only lead to more confusion. Hence, a growing awareness in the future that more attention will need to be devoted to coordination of satellite and terrestrial policies will enhance the ability of this industry to grow.

IV. CONCLUSION

The growth in popularity of satellite broadcasting has focused much attention on the potential for growth in this market to satisfy the large consumer demand. New satellite proposals promise to meet the projected demands but the growth of opportunities will continue to raise challenges for programming distributors.

COMSAT'S ROLE IN THE PACIFIC:
THE ADVANTAGES OF THE GLOBAL NETWORK

a Speech by

Betty C. Alewine
President, COMSAT World Systems

Pacific Telecommunications Council Conference
January 13, 1991

Good morning ladies and gentlemen. For the first few moments of my speech today, I'm going to talk about "it". Now what is "it"?

It was praised for its role in liberating Kuwait. It helped spread the seeds of democracy in what used to be the Soviet Union. Two years ago, it received rave notices for drawing the world's attention to Tiananmen Square. It even helped tear down the Berlin Wall.

I am, of course, talking about the global communications network. While it has played a part in historical political change, it has also contributed significantly to the "economic miracle" of the Pacific Rim. That's why I am here today and delighted to participate in a discussion of the global network and COMSAT's role in bringing its advantages to this region.

Over the past two decades, the nations of the Pacific have forged the fastest industrial revolution the world has ever seen. Just since 1985, these countries have enjoyed the highest economic growth rates in the world, ranging from 4 percent in Japan to 10 percent in Thailand. And the miracle is far from over. Some say it is accelerating and predict that by the year 2000, the combined economies of the Pacific will reach $13 trillion, twice the size of post-1992 Europe.

Many factors have contributed to this remarkable economic performance. Among the most important are the declining costs and improving quality of international telecommunications. For countries depending on exports for growth, efficient and reliable communication with trading partners is essential. Taking note of the success of Japan, Korea, Hong Kong and Singapore, governments in the rest of Asia have begun to act on the idea that the country with the best infrastructure and access to the global network will attract the most foreign investment, manufacturing and financial institutions. No wonder modernization of telecommunications has become a national priority in Thailand, the Philippines, Indonesia, and Malaysia.

The tremendous growth in demand for telecommunications has attracted all kinds of international service providers to the region, each striving to deliver the best quality at the lowest

price. Recognizing the value of competition to the end-user, governments are deregulating telecommunications markets. By increasing competition, they want to further accelerate the growth in services that are so desperately needed.

Their efforts are paying off. Intense competition is driving down prices and expanding choices for both consumers and business users. Today, international users have a lot to choose from. In addition to the global network of INTELSAT, on which COMSAT provides services to and from the United States, there are regional satellite systems and fiber optic cables.

To get an idea of how important the Pacific Region is to COMSAT, consider these trade statistics: Trade between North America and the rest of the Pacific Rim was worth $20 billion in 1970. By 1990, it had increased more than ten-fold to $275 billion. To emphasize the opportunity this represents for U.S. firms, the former governor of California, George Deukmajian once said, "There is a $3 trillion market our there, and it's growing at a rate of $3 billion a week."

That volume of business has to be supported by the kind of efficient, reliable and affordable communications between the U.S. and the Pacific that COMSAT can provide.

Our international business service (IBS) in the Pacific has been growing at a rate of about 25 percent annually since 1988. In spite of alternative transmission options, growth remains strong. Even as I speak, we are in the process of implementing 24 IBS circuits worldwide. Ten are in the Pacific. These new circuits will serve customers in Australia, New Zealand, Guam, Hong Kong, Singapore, Malaysia, and the People's Republic of China.

The broadcast side of our business is equally exciting. International satellites are uniquely qualified to support increasingly sophisticated requirements for satellite news gathering and program distribution. In 1991, the number of occasional-use hours leased in the Pacific increased by 600 percent, in part because of the Persian Gulf War.

Full-time leases have also increased in the region because market conditions have changed. In Japan, for example, broadcasters, previously covered by one pooled lease, now each have their own 24-hour leases. They have all installed customer-premise antennas, so individual leases are more convenient.

But the size and diversity of the market isn't the only thing that's important to us about the Pacific. Here, we can put to work the full range of services and capabilities that distinguish COMSAT from the competition.

You may be expecting me to elaborate on this point by reciting COMSAT's technological achievements that have made

satellite communications the robust business it is today. True, we still exploit all the latest technological innovations to ensure satellites a position in the networks of the future. But COMSAT is no longer the technology-driven company it was when it started out in the 1960s.

Then the company was armed with a good idea, the technology to make it real, and the determination to awaken the market. Today, the market has its own momentum. Customers want to move information, whether it's voice, data or video. They don't care how they send and receive it -- by satellite or cable -- as long as their service is cost-effective and reliable, and there when they need it.

Recognizing this fundamental change in the market, COMSAT has changed, too -- changed the way we manage and operate our business. Today, the requirements of our customers drive our business. Technology and the regulatory environment are, of course, important factors in what we are able to do, but neither is the driving force. Our job is to provide service on the INTELSAT global network to and from the United States. The way we convert our customers' needs into services on that network, or into satellite investments for the future will determine our success in the competitive marketplace.

Focusing first and foremost on our customer needs is the only way we can meet the competition head on. This focus demands that we manage and operate our business to deliver consistently high quality services that are affordable, flexible, easy to use and reliable. It permeates every single facet of our business -- sales and marketing, new service development, operations and engineering, technical services, pricing and billing.

Let me explain from a management perspective how this has changed COMSAT. Let's start with affordability. Price may not be the only factor in a customer's decision, but in a competitive market, we don't expect to get past the front door without a competitively-priced service.

From the beginning, COMSAT has continually passed on to its customers the benefits of economies of scale inherent in newer satellites and the savings made possible by digital technology. Market forces also affect our pricing.

Earlier this month, for example, we lowered our rates on international digital-switched voice services by as much as 58 percent. This, of course, depends on the duration of the contract and the volume of business in each of four region, one of which is the Pacific. With this new tariff, we are quite competitive with fiber optics cable to many Pacific locations. We are also ready to compete with the new lines scheduled of the future. The message to our customers is clear: We are going to

compete aggressively for your business today and for a strong share in future growth.

We have also extended a promotional tariff for our IBS customers in the Pacific Region, offering a discount to those who make the most efficient use of satellite capacity.

And, last year, we lowered occasional-use television rates to enhance this increasingly popular service. Rates on the first ten minutes on primary and major path satellites have been reduced by 12 percent. Rates on each additional minute have been lowered by the same amount.

With our focus on customer requirements, we also began about five years ago to alter our approach to sales and marketing. Everyone -- let me repeat, everyone -- in COMSAT World Systems is part of our sales force, directly or indirectly. We have instituted an account management organization so that each customer has a single point of contact. You make one phone call, and the account manager takes it from there, coordinating the technical and operating resources needed to solve your problem.

The account managers are the ears and eyes of our corporation. What they learn from our customers translates into improvements in services as well as plans for new satellites.

We augment individual contact with special meetings. For example, each year COMSAT hosts a User-Provider Meeting for our broadcast customers. The meeting is an annual opportunity for customers to talk openly about their problems, not only with COMSAT managers, but also with representatives of other INTELSAT signatories. We started the User-Provider meetings five years ago with 20 people sitting around a table. In 1991, 150 participants attended. It has evolved into an annual institution.

The success of the User-Provider meetings for our broadcast customers led us to undertake a similar effort for customers on the pure voice and data side of the business. The first conference of this type was held in December, and we plan another in October 1992.

Regional meetings are also essential. Some of you may have attended the Pacific briefing held jointly by our marketing, sales, and operations staff last September here in Hawaii. That meeting focused on the particular concerns of carriers serving the Pacific Islands. The main topic was digital services. As a result of the discussions, digital implementation went more smoothly for these customers in the fourth quarter. And we ended up with three new contracts for long-term service.

We incorporate what we learn into the development of new

services. VSATs are an excellent example. Given the huge popularity of VSATs in the United States, and the availability of higher-powered satellites to transmit to small antennas, it seems only a matter of time before the international VSAT business will take off, too. Recognizing this market potential, COMSAT introduced a VSAT tariff in December.

I am also pleased to announce we have just filed with the FCC to start a digital audio distribution service in February. This new service caters to the emerging international direct-to-cable audio market. The potential of digital audio is exciting. Imagine receiving hundreds of CD-quality programs from around the world, live, via satellite, through cables into your home. So that our customers can test-market the service, COMSAT will offer promotional rates for up to six months of trail use.

We continually adapt our existing services. Five years ago, a customer had few choices in the kinds of leases that were available. Today, we offer a complete menu of services -- long-term, medium-term, short-term, and occasional-use.

In 1988, we established a technical service department which provides the operating expertise to solve client problems identified by sales and marketing. At the Seoul Olympics, for example, COMSAT technical service and sales staff worked on-site, in coordination with KTA and INTELSAT, to support our network and other customers. Building on the first-hand experience gained spending long hours in the international broadcast center in Seoul, we are well along in our plans for this year's winter and summer Olympics in Albertville and Barcelona. A COMSAT team of sales and technical managers will once again provide on-site support in cooperation with the host signatories.

Then there is responsiveness to the unexpected. On December 7, 1991, a Japanese television network wanted to broadcast the Pearl Harbor Commemoration ceremonies held not far from where we sit today. Unfortunately, all normal satellite channels between Hawaii and Japan had already been booked. We at COMSAT understood the importance of the event being broadcast, and solved the problem by beaming the ceremonies on an available channel to the U.S. and then beaming that signal to Japan on another satellite. Through this creative solution, we were able to give Japanese viewers instantaneous access to what they wanted to see.

Another service that exemplifies our flexibility is cable restoration. Although cable operators compete with us on heavily used routes, we also consider them good customers. Even heavily-armored fiber cables sometimes fail. When that happens, COMSAT, through INTELSAT, quickly restores traffic usually within an hour of the outage. In 1991, alone, we restored cable traffic on 14 separate occasions amounting to 191 days of cable restoration

service. That's half a year.

We have also made our services easier to use. In 1989, we inaugurated a computerized ordering system called COMSAT Television Scheduling Service, or CTVS. Occasional-use customers can access instant information on earth station and satellite availability in the INTELSAT network. They also find up-to-date information on earth station capabilities, satellite configurations, and international broadcast rates. Today, more than half our normal business inquiries for occasional-use services come through CTVS. And we are continually upgrading the system's capabilities. In the near future, we will add a "bulletin board" feature to announce new satellites, rates, special events and other news.

Lastly, how have the changes at COMSAT affected the way we do business through the INTELSAT organization?

In my view, there is no effective substitute for the global network that years of successful cooperation among diverse interests have achieved. Together, the signatories of INTELSAT have built a great foundation. With that foundation and the additions we make to the network in the future, each signatory is able to offer top quality service to its customers.

Most INTELSAT signatories face the same market forces we do. National governments are deregulating many businesses. Some are moving more quickly than others. But the direction is clear. Governments are trying to create regulatory frameworks that allow market forces to function more freely for the benefit of the consumer.

Whether you believe that regulation protects or hinders, we all must win business today in the marketplace, and we must win it competitively.

Perhaps the most critical issue within INTELSAT today is that of satellite capacity -- how much is needed, where, when? This is a business decision. Our approach begins with the customer focus I have just described. COMSAT and INTELSAT will make sure our customers' requirements are well reflected in the services we introduce and the investments we make in new satellites, such as the INTELSAT VII series.

The INTELSAT VIIs, scheduled for deployment in 1993, are the first satellites designed specifically for the Pacific market. And we are excited about its capabilities such as enhanced coverage, power and connectivity, plus the ability to work well with small antennas.

Even before the VIIs are launched, we are working with INTELSAT to prepare for the post-1995 era. At INTELSAT's

December Board of Governors meeting, we approved the issuance of an RFP for follow-on satellites. We are also considering alternative designs specifically targeted toward markets that are best suited to use satellites. This is especially important in the Pacific, where geography is so conducive to satellite communications.

Today, routine news events are transmitted instantaneously throughout the Pacific. Stock markets in Tokyo, Taipei and Hong Kong rely on rapid data transfer. Everybody, it seems, has his or her own fax machine. Personal overseas communications have never been easier or more affordable. Whether it's a Persian Gulf soldier using digital voice service to phone home during the Gulf War or a sports fan thrilling to an Olympic event half a world away, satellite communications have changed all our lives.

In closing, I have to tell you, it's wonderful to be here in Hawaii, away from the pressures of my office. It's great to look out over the water and see nothing but, well, water. For a minute or so, we feel peaceful, separated. But when you think about it, even though we're here on an island in the middle of the Pacific Ocean, there are no islands anymore.

What's most thrilling about satellite communications is that our customers and users can take advantage of amazing technological achievements without thinking twice. All of us today will phone home, click on television, or transmit a fax. We are really just next door to our loved ones and business associates.

Thanks to the global communications network, we are all linked together. Almost wherever we go, in the Pacific or around the world, we're becoming one big community. The challenge for COMSAT is to make sure that billions of people can be part of that community. I guarantee that we will continue to do just that.

Thank you very much.

An Exercise in Privatization: The Making of Telekom Malaysia

by:

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1. ABSTRACT

The privatization of Malaysian government-owned and operated public utilities has been a major aspect of the development agenda since the early 1980's. It was generally perceived by policy makers as the sine qua nom of the country's economic growth and future development. Among the services initially earmarked for privatization were the transport and telecommunication sectors. This article takes a retrospective look at the Malaysian government's privatization policy with respect to the formation of Telekom Malaysia and explores the telecommunication scenario vis-a-vis the biggest public-listing exercise in Malaysia's corporate history.

2. INTRODUCTION

An advertisement which regularly appears in *Utusan Malaysia*, a leading Malay-language daily, features a *tabib* (practicioner of traditional Malay medicine and other means of sex therapy) publicizing his services which purport to guarantee enhancement of men's sex life and general health. This particular advertisement would seem ordinary except that it

carries the picture of the *tabib* clutching a cordless phone close to his ear. One can easily get this picture of a high-tech traditional medicine man at work. Blessed with this new gadget, men from around the world, especially those afflicted with problems of a sexual nature, can now contact him almost instantaneously.

The above example serves to illustrate the important role modern telecommunication plays in the day-to-day affairs of Malaysians both in their private and public life. Even street hawkers nowadays take orders from their regular customers with the aid of mobile phone sets. And it is not uncommon especially for businessmen to be equipped with hand and/or car phones.

Indeed, with each passing day, new innovations accompanied by a good measure of excitement seem to color Malaysian telecommunication. Notwithstanding the availability of new and improved value-added services such as MAYCIS (Malaysian Circuit Switched Data Network) and MAYPAC (Malaysian Packet Switched Public Data Network), Telekom Malaysia's data communication services to commercial enterprises, *Telita* (videotex transmission), itemized customer billing and mobile telephony, last year (1991) witnessed events promising even bigger strides in the country's telecommunication development. Among them are:

i) the signing of the memorandum of understanding (MOU) held on the island of Langkawi which will pave the way for the launching of Malaysia's own geosynchronous satellites in 1994. The satellites, known as Measat (or Malaysia East Asia Satellites) and costing U.S$250 million, are to be owned and operated by Binariang Sendirian Berhad, a Kuala Lumpur based company. Built by America's Hughes Communications International Inc., the satellites are expected to be launched in 1994 off Kourou in French

Guyana by Arianespace of France;[1]

ii) the launching of the second phase of Telekom Malaysia's pilot ISDN (Integrated Services Digital Network) project. Initially to cover the populous Klang Valley in Peninsular Malaysia, ISDN systems are expected to be operational on a commercial basis in 1993. With the availability of ISDN -- where digitized voice, data, text and images can be communicated via a single line -- Malaysia is poised to become the third country in Asia after Japan and Singapore to provide such sophisticated circuitry;[2]

iii) the completion and launching of a submarine optic-fibre cable link between Kuantan on the east coast of Peninsula Malaysia and Kota Kinabalu in East Malaysia. This optical-fibre link is expected to enhance the quality of telephone and broadcast transmission links between East and West Malaysia and support new services.[3]

The events, each a milestone in the development and expansion of telecommunication infrastructure and services in Malaysia, were largely viewed as being the manifestation of the deregulation and privatization policies adopted by the government in the early eighties in so far as the telecommunication sector is concerned. Deregulation of the telecommunications environment had also provided the impetus for entry of locally incorporated as well as foreign-based companies to compete for a slice of certain telecommunication services like pay and credit-card phones, mobile telephony, and paging systems. Competition among the telcos has generally enhanced their productivity apart from sensitizing their staff to the importance of maintaining high-level customer satisfaction.

Rapid advancement in state-of-the-art telecommunications technology in the last two decades also dictated that the Malaysian government revamp the administrative structures and management function of Jabatan Telekom

Malaysia (JTM), Telekom Malaysia's predecessor. JTM had been the government department in charge of providing telecommunication infrastructure and services nationwide. Encumbered with administrative procedures and regulations, it was generally felt by policy makers that, as a government department, JTM would be in no position to provide a viable network let alone run a profit oriented telecommunication service for the country.

Besides the rapid advancement in telecommunication technology, there were other conducive factors responsible for the privatization of telecommunication services in Malaysia. These will be discussed in the following section.

3. PRIVATIZATION: THE BEGINNING

The thrust for the privatization of government owned and operated public services had largely come from Malaysian Prime Minister Dr. Mahathir Mohamad when he assumed the mantle of leadership in 1981 from former Prime Minister Hussein Onn. Dr. Mahathir initiated a series of policy changes -- often viewed at that time as drastic by some and with skepticism by his detractors -- viz. his Look East policy, emphasis on heavy industries, and, of course, privatization. Although critics had expressed reservations saying that "nepotism and corruption" can easily rear their ugly heads if privatization is not executed according to the book and done openly, it is generally felt that the majority of Malaysians do not want privatization stopped altogether as many consider their state-owned and run utilities inefficient.[4]

Ailing government corporations and obligations on the government's part to finance and provide certain public services strained the country's

finances. The corporatization and, later, privatization of these government entities were recognized as possible options to relieve the government of its financial burden and resuscitate some of its financially-strapped corporations and utility providers. Futhermore, the onslaught of recession in 1983 convinced the Mahathir Administration that the private sector should be accorded a bigger role in the provision of social services and amenities and hence reduce government expenditure on such services.

The Cabinet entrusted the Economic Planning Unit (EPU) of the Prime Minister's Department with the task of coming out with a comprehensive national privatization masterplan, one in which the government envisages should:".....enhance the role of the private sector in the economy while at the same time creating new opportunities for the public, in particular the employees of the privatised projects as well as the Bumiputera community to own wealth through the purchase of shares in these projects".[5]

3.1 **Privatization: The role of the EPU**

Privatization, by the end of the 1970's was becoming an international catch-cry and Malaysia, which did not lose time in recognizing it as an instrument for spurring economic growth, co-opted it into its development agenda. The Economic Planning Unit (EPU) of the Prime Minister's Department set to work out the best possible privatization formula that took cognizance of the country's development goals and priorities. Based on an analysis of two EPU publications focusing on implementation guidelines of the policy,[6] privatization's major guiding principle can be summarized as follows: provision of strategic services in an efficient, profitable manner but without sacrificing public needs and jeopardizing the interests of the ruling political party.

Identification by the EPU of potential candidates for privatization got underway in 1982. Among the earliest to be identified were the Malayan Railway, the Port Klang Container Terminal, National Padi and Rice Board's rice milling complexes and the Royal Malaysian Navy Dockyard located in Lumut. This was followed by moves to corporatize and then privatize the National Electricity Board, the Telecoms and Postal Departments. Up till the end of 1991 and since the formal implementation of the privatization policy in 1983, 37 projects have been privatized, 27 of which were once government entities but now taken over by private companies either through outright management buy-outs or by sale of equity or assets to the public. The government earned U.S$437 million through sales of its interests in entities which it had owned and, more important, was financially relieved of some U.S$3 billion when it no longer has to fund infrastrusture development and operating expenses.

The EPU subscribes to two other basic types of privatization implementation methodology: "Build-Operate-Transfer" (BOT) and "Build-Operate" (BO). The BOT concept requires interested companies to submit proposals. If approved, the company constructs the facility with its own funds and is allowed to collect revenues from users over a specific period of time. The construction of highways and collection of toll is an example of this. The BO scheme is largely similar to BOT but the company concerned does not transfer its assets or facility to the government. An example of BO is Sistem Televisyen Malaysia Berhad (STMB). Granted a license by the Ministry of Telecommunications, Post and Energy in 1985, it now operates a private commercial TV station (TV-3) nationwide. STMB's ownership, however, is closely linked to the investment arm of UMNO or United Malays National Organization, the major component of *Barisan Nasional*, the ruling

coalition, as well as to other organizations linked to the other leading political parties in the coalition.

Besides recommending government entities for possible privatization to the Cabinet, the EPU also reviews proposals from various private companies keen to take over state-owned and operated entities. The process, as illustrated in Figure 1 (see next page), also involves the appointment of consultants to undertake a feasibility study once a proposal is submitted via the EPU to the Cabinet. Based on the respective consultant's appraisal and recommendations, the Cabinet would then seek passages of legal amendments to existing statutes like the Pensions Act of 1980, the Telecommunications Act of 1950 and the Electricity Act of 1949 in order to facilitate the smooth transfer of government assets to private companies established under the Companies Act of 1965.

Proposals to buy out or take over the running of state-owned services must take cognizance of the objectives of Malaysia's privatization policy, viz.:

a) relieve the financial and administrative burden of government;

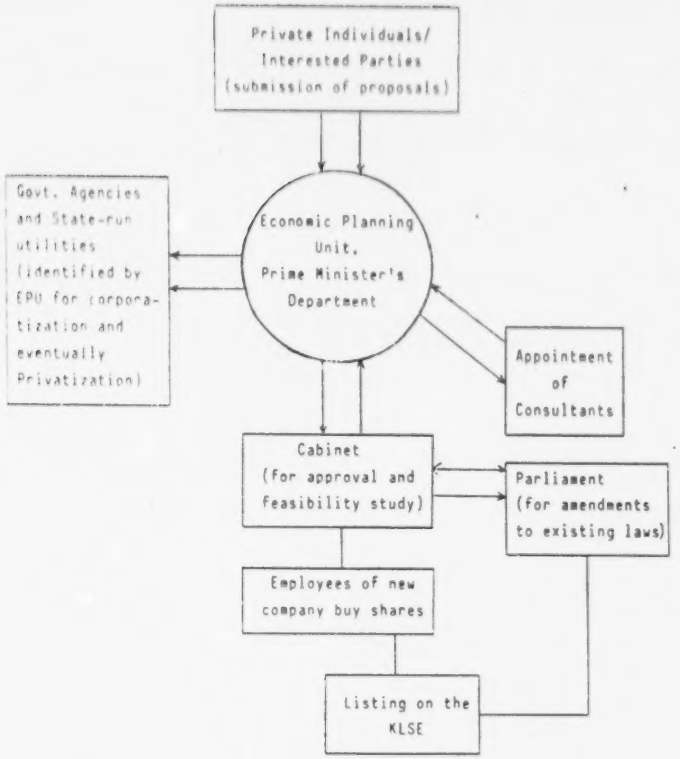
b) improve efficiency and productivity;

c) facilitate economic growth;

d) reduce the size and presence of the public sector in the economy; and

e) help meet the national economic policy targets.[7]

Reflective of the policy objective mentioned in (e), privatization also is seen as an instrument to enhance *Bumiputera* (indigenous) equity stake and participation in the corporate sector. Apart from this, employees of newly-



Steps in the Privatization Process

1. Identification by the EPU of state-owned and run utilities and services for possible privatization: Proposals submitted by interested parties to the EPU.
2. Analysis, Review and Recommendations by EPU to the Cabinet.
3. Cabinet approval; appointment of consultants
4. Cabinet proposes new laws and amendments to existing statutes for passage by Parliament.
5. New company/corporation set up under the Companies Act of 1965 to take over ownership/management of state-owned and operated agencies/utilities.
6. Sale of shares to Employees.
7. Prospectus and sale of shares to the public.
8. Listing on KLSE.

Fig. 1: Major Entities and Steps in the Privatization Process

privatized entities are expected to gain from higher remuneration and benefits concomitant to the implementation of various incentive schemes which otherwise are not usually found in government departments and agencies. They can own a part of the company through such schemes as the Employee Shares Ownership Plan (ESOP) and Management Employee Buy-Outs (MEBOs) as prescribed in the privatization masterplan.

As for foreign ownership, certain conditions apply, particularly in terms of the value and amount of equity held in a company, which must not be in the majority. Foreign ownership is allowed only if its:

a) expertise is needed to upgrade efficiency and such expertise is not available;

b) participation is necessary to promote the export market;

c) purchase of shares will help supplement the supply of local capital; and

d) participation will enhance global linkages and international exposure.[8]

The next section looks at the biggest transfer exercise of public assets and services to a largely government-owned company as well as the largest public listing exercise in Malaysia's corporate history. It also offers a brief assessment of Telekom Malaysia's performance besides exploring the company's prospects in the near future.

4. TELEKOM MALAYSIA: PERFORMANCE AND PROSPECTS

The Malaysian telecommunication environment was poised to enter a new era of growth and expansion when, in 1987, the government transferred JTM's assets and operations to a corporation known as Syarikat Telekom Malaysia (STM).[9] The transfer not only heightened public

expectations at home but also attracted the attention of foreign investors. Malaysians, not unlike the foreign investors, expected an overall improvement to their telecommunication services, albeit, shorter waiting periods for telephone installations and repairs.

Apart from this, an important pre-requisite to more foreign investments into the country is an efficiently-run and up-to-date telecommunication infrastructure and related services. The desire to enhance connectivity to the transnational corporate structure and to keep pace with modern information and communication technology spelled the creation of a carrier unshackled by cumbersome government procedures. Hence, the move to inevitably privatize JTM.

4.1 Floatation of Telekom Malaysia Shares

Three years following JTM's "corporatization", the new company, STM, was ready to have its shares listed on the Kuala Lumpur Stock Exchange (KLSE).[10] A total of 470.5 million new ordinary shares -- representing 23.8% of the corporation's issued and paid-up capital -- were floated in September 1990. The issue price was M$5.00, or approximately $U.S1.80 per share, which was thought to be rather high for an introductory issue. At the end of the day, the sale of its shares was oversubscribed by only 1.03 times, a figure far below what industry analysts had expected. Hesitations were largely attributed to uncertainties in the Middle East (Iraq's invasion of Kuwait) and Malaysians typically saving up for incidental end-of-year expenses.

In line with the government's policy of enhancing indigenous equity stake, Telekom Malaysia reserved slightly more than 30% of the issued shares to *Bumiputera*-related institutions and individuals. Five-percent

were allocated to foreigners while another 15% were meant for its employees and eligible employees of JTM. Through what was known as "pink forms", employees, nearly all of whom had opted to serve with Telekom Malaysia, were privileged to purchase their company's shares. Almost all did but some resold them hoping to make quick gains when Telekom Malaysia share price fetched U.S$2.40 per unit on the KL bourse. This unforseen behaviour on the part of the employees later led the Economic Planning Unit to co-opt the Employees Share Ownership Plan (ESOP) into its privatization policy. ESOP involves the setting up of a trust to hold shares for employees. With such a scheme, employees can only sell their shares when they leave the company or when they retire.

Based on Telekom Malaysia's 1990 Annual Report, the government of Malaysia, through a body corporate established under the Minister of Finance (Inc.) Act, 1957, holds the majority or 76% (slightly worth more than one-half billion U.S. dollars) of Telekom Malaysia shares. Individuals from Malaysia own 3.3% of the total share value (or U.S. $24.5 million) and foreigners, including Singaporeans, 3.7% or U.S.$27.3 million (see Appendix 1).

4.2 Telekom Malaysia's Performance: An Overview

If profits are any measure of Telekom Malaysia's performance, then the telecommunication behemoth is, indeed, a success story. Telekom Malaysia has in the last three years been viewed as a national phenomenon: the flagship of the government's privatization policy. Figure 2 indicates the extent of Telekom Malaysia's steady gains in its pre-tax profits since corporatization in 1987. Since then, the government has, as an incentive, not taxed Telekom Malaysia's earnings and this, analysts say, remains an

important stabilizing factor of the company's share price on the KLSE. Telekom Malaysia's share price rose to a high of U.S$4.50 in May, 1991

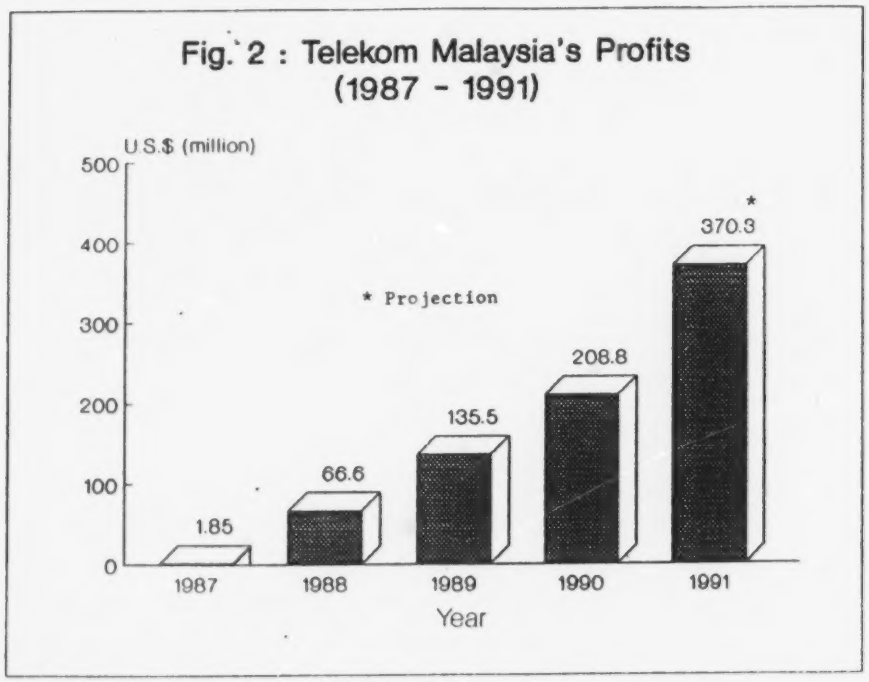


Fig. 2 : Telekom Malaysia's Profits (1987 - 1991)

only to ease off at U.S.$3.70 at the end of the year, far below that of U.S.$7.40, a price stock marketeers predicted the shares could fetch but never did. Nonetheless, the company expects to achieve an unprecedented pre-tax profit of U.S$370 million for 1991.[11]

Apart from making available an array of sophisticated digitized data communication services as well as domestic and international toll-free dailing, waiting period for phone installation has also been cut from six

months to roughly two weeks since the company's inception in 1987. Telephone density per 100 inhabitants, too, has risen from 6.8 in 1982 to 9.2 in 1991. With steady increases in line installations, the company expects to increase density to 25 by the year 2000, thereby inching Malaysia closer to the ratio achieved by developed countries. Hopefully, services, especially that of residential telephones, will be equitably spread nationwide. Presently, telephone density and various other value added services are concentrated in major cities. Those in rural areas (where density is two per 100 inhabitants) often complain of difficulties of access to good, working telephones. Despite the shortcomings, it is, however, heartening to note that Telekom Malaysia is allocating U.S.$630 million to expand and upgrade rural telephony during the Sixth Malaysia Plan period (1991 - 1995). And over the same period, too, about U.S.$3.70 billion worth of capital investment will be made mostly by Telekom Malaysia to upgrade and maintain telecommunication infrastructure in Malaysia, making it one of the fastest and largest growth market for telecommunication equipment in the Asia-Pacific region.[12]

5. CONCLUSION

We are said to be entering the Information Age -- an era characterized by the synergy of tele-communication technologies and computers continually transforming the manner, speed and volume by which data, voice and images are communicated across the globe. The rapid advancement in communication and information technology especially in the last two decades had necessitated a re-examination of telecommunication policies both in developed and developing countries and the fine-tuning of regulatory frameworks governing their use.

In Malaysia, apart from the rapid advancement in telecommunication technology, other factors have spurred the privatization of the country's telecommunication services, viz.:

i) the need to enhance connectivity to the transnational corporate structure and the global marketplace,

ii) the government's own need to relieve itself of the burden of expenditure on public utilities, and

iii) the need to enhance indigenous ownership of the country's corporate wealth.

One of the bigger challenges facing Telekom Malaysia is ensuring proper balance between an efficiently-run, profit-oriented company and commitment to social needs and public interest. As for the former, Telekom Malaysia has proven itself reasonably well judging from:

i) steady increases in profits made since its inception in 1987,

ii) its shares are viewed by industry analysts as growth utility stock, and

iii) its ability to settle outstanding loans.

As for meeting social needs, much is left to be desired. Rural telecommunication is in dire need of improvement let alone expansion. Much of the advanced services are urban-centered, mostly catering to the needs of the mercantile community. In the educational sector, it is felt that Telekom Malaysia should chart a more visible and active role toward enhancing education via use of its own array of telemedia delivery systems. Academicians in the country feel that the new video teleconferencing facility which Telekom Malaysia plans to introduce will cater more to the needs of the corporate world. What is needed then is closer cooperation between

Telekom Malaysia and institutions of higher learning and strategic planning that would enhance distance learning and telelectures through the videoconferencing mode.

In their study of ASEAN's telecommunication policies and trends in infrastructure development, Hukill and Jussawalla (1991) felt that network expansion in the country is bound to put pressure on traditional culture as westernization gets the better of Malay/Muslim values and as such could prove destabilizing to Malaysia's multiracial polity.[13] While this may be a legitimate concern, but this writer, reverting to the story of the *tabib* with which he began this paper, is inclined to believe that what is important is the harmonious blending of modern technology and the utilization of new information and communication technologies to also suit local needs and values. The case of the *tabib* (traditional Malay medicine man) serves to illustrate this point.

With expanded networks and the globalization of telemedia delivery systems, Telekom Malaysia should cooperate more closely with the local entertainment and cultural industry and assume a catalytic role to balance out the flow of entertainment, knowledge and information-based products -- which has long been in favor of the developed Western countries -- at least within the Asia Pacific region.

All said, the telecommunications sector in Malaysia is certainly poised for further expansion as the nation's economy continues to show signs of stable growth. Telekom Malaysia is expected to assume an important pivotal role in the nation's economic growth and in tandem with the nation's aspirations of becoming a significant player in the international marketplace and achieving developed country status by the year 2020.

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Endnotes

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[1] See "Signed: $675 million deals for our 1994 satellite launch" in New Straits Times, November 6, 1991, p.1-2.

[2] See: "Telekom begins second phase of ISDN project" in Computimes (New Straits Times supplement), May 30, 1991, p.1.

[3] See: "Five new services in two years" in Computimes (New Straits Times supplement), November 14, 1991, p.15.

[4] See: "In Malaysia, Dial 'P' for profit" in Asiaweek, September 15, 1989, 57-63.

[5] See: "Foreword" by the Prime Minister of Malaysia, Dr. Mahathir Mohamad, in Privatization Masterplan, Kuala Lumpur: Economic Planning Unit, Prime Minister's Department, (February, 1991).
The term *Bumiputeras* refers to indigenous Malaysians who are predominantly Malays, and residents who are descendants of the various tribes of the East Malaysian states of Sabah and Sarawak. Malaysians of Chinese and Indian origins are not usually classified as *Bumiputeras*

[6] The documents are: Guidelines on Privatization (1985) and Privatization Masterplan (1991).

[7] Privatization Masterplan, op. cit. p. 21.

[8] Privatization Masterplan, op. cit. p. 27

[9] Syarikat Telekom Malaysia (STM) was incorporated on October 12, 1984 under the Malaysian Companies Act of 1965. On January 1, 1987, STM officially took over the operations of Jabatan Telekom Malaysia (JTM) under license issued by the Ministry of Energy, Telecommunication & Post. Coinciding with the September, 1990 floatation exercise, and as a strategy to enhance its image internationally, STM's management decided that the company was to be simply called Telekom Malaysia thereafter, and adopted a new corporate logo as well.

[10] The listing on November 7, 1990 of Telekom Malaysia's shares was the first and biggest floatation exercise by a major public utility on the KLSE. It raised some U.S.$730 million for Telekom Malaysia and was expected to increase the market capitalization of KLSE by about U.S.$3.7 billion.

[11] See: "Telekom on course to score billion" in New Straits Times, July 26, 1991, p. 14.

[12] See: "Investment in Telecommunication projects to exceed $10 bilion" in The Star, November 11, 1991, p. 7.

[13] Hukill, Mark A. and Jussawalla, Meheroo. (1991). Trends in Policies for Telecommunication Infrastructure Development and Investment in the ASEAN Countries. Institute of Culture and Communication, East-West Center, Honolulu, Hawaii.

APPENDIX 1

LOCATION OF TELEKOM MALAYSIA'S SHARESHOLDERS

TYPE OF OWNERSHIP	SHAREHOLDERS	%	SHAREHOLDINGS	%
COMPANIES IN MALAYSIA				
NOMINEES COMPANIES	28	0.0660440	99,753,000	5.0623192
BUMIPUTERA CORPORATIONS	24	0.0566091	49,204,435	2.4970533
OTHER COMPANIES	207	0.4882536	4,588,000	0.2328343
MALAYSIA RESIDENTS				
MALAYS	21,929	51.7242195	37,183,000	1.8869830
CHINESE	16,831	39.6995000	22,398,000	1.1366658
INDIANS	2,921	6.8898009	5,462,000	0.2771885
OTHERS	347	0.8184734	920,000	0.0466887
GOVERNMENT AGENCIES	28	0.0660440	1,677,371,566	85.1241598
MALAYSIA TOTAL	42,315	99.8080445	1,896,880,001	96.2638926
COMPANIES IN SINGAPORE				
NOMINEES COMPANIES	25	0.0589678	68,884,000	3.4957625
OTHER COMPANIES	3	0.0070761	1,000,000	0.0507485
SINGAPORE RESIDENTS	44	0.1037833	185,000	0.0093884
FOREIGN INVESTORS				
BRITISH	1	0.0023587	1,000	0.0000507
HONG KONG	2	0.0047174	2,827,000	0.1434661
AUSTRALIANS	2	0.0047174	8,000	0.0004060
AMERICANS	1	0.0023587	700,000	0.0355240
CANADIANS	1	0.0023587	9,000	0.0004567
OTHERS	1	0.0047174	6,000	0.0003045
FOREIGN TOTAL	81	0.1910555	73,620.000	3.7361074
GRAND TOTAL	42,396	100.0000000	1,970,500,001	100.0000000

Source: Telekom Malaysia Annual Report, 1990

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The Need for a Universal Response to Disaster Relief

Prepared for the Pacific Telecommunications Conference
January 15, 1992

Louis Bransford
Bert Cowlan

Abstract

If society is to deal adequately with the tyranny of disaster, there is an urgent need to find and test new technologies which can survive both the forces of nature unleashed or those disasters assisted or produced by man-made means. The need for information: more, better, accurate, reliable, timely, available, affordable, arises time and again in the deliberations of organizations concerned with disaster communications. Most existing telecommunications systems are subject to vulnerabilities of size, survivability, affordability, portability and ease of use in a disaster situation. Some require external power sources; some are too large to be quickly put in place; and some need time-consuming governmental approval to be deployed. In most instances, throughout the developing world, these large, cumbersome packages are too expensive to be stockpiled where most apt to be needed. The new technological movement predicated on widely disbursed personal communication units fills a need in disaster communication and is the subject of this paper.

Introduction

Cyclones, hurricanes, typhoons, floods, tidal waves, earthquakes, forest fires, mud slides, volcanic eruptions, tsunamis, drought, tornadoes, water pollution: these constitute a litany of natural disasters that has plagued the earth from its genesis. Add to this ship, plane and train wrecks; nuclear accidents and war; acid rain and other man-made catastrophes from which no nation is safe.

Many of the disasters enumerated above are common to this part of the world in which we are gathered. As this is being written, Guam is still recovering from a typhoon that struck with 150 mile-an-hour winds.

A few months ago, speaking to the General Assembly of the United Nations, President Bailey Olter of the Federated States of Micronesia spoke eloquently of the island nations' fear of global warming and a subsequent rise in the sea level which would

literally wipe out the low-lying atolls which constitute many of the countries of the Pacific Basin.

The thousands of small islands, far from each other and prone to natural disasters, that dot the vast expanse of the Pacific Ocean, have strongly expressed their point of view towards improved disaster communications.

> "A communication system can be an instrument of great influence...no one should question the need for a reliable telecommunication service. Links between our islands are virtual lifelines."
>
> Ratu Sir Kamisese Mara
> Prime Minister, Fiji

The Role of Communications

Disasters throughout the world are compounded when communications systems and services are either non-existent or disrupted. The need to communicate: to warn people of impending disaster, to coordinate and manage relief operations, to report to the relief agencies and the general public, requires universal, flexible, portable, efficient and affordable technology.

When disasters build up slowly there are, fortunately, tools to detect them. However, when disaster strikes with the speed of a typhoon, a volcanic eruption, or an earthquake, the need for assistance is immediate. In either case, especially in the developing world, which has the least means to detect and manage disasters, the most urgent need by those mandated to provide assistance and relief is for information. (What has happened? What is needed? Where is it needed? What roads or airfields or ports or supplies are left passable and intact? What information needs to be shared? With whom?)

The world's response to disaster has been generous regardless of political divisions, diversity, or disagreements. The best of intentions have often gone begging because communications systems, the nerve center of disaster warning, assistance, management and relief, are often a first victim. Power stations fail and power lines go down. Large satellite antennas often are inoperative in gale force winds. Personnel cannot reach their duty stations. Today, there is no universal, affordable and reliable communications system that can be activated on short notice.

The United Nations and the Relief Agencies

Leading relief agencies, such as the United Nations Disaster Relief Organization (UNDRO) or the International League of Red Cross/Red Crescent Societies, or the host of other governmental, nongovernmental and private voluntary organizations, all eager and able to help, lack information and emergency communications service. The literature of disaster relief abounds with too many well-meaning efforts, which have resulted in personnel and supplies being sent to the wrong place or of the wrong kind for the needs of the specific area or never arriving because directions were never made clear. Portable communications, unencumbered by terrestrial mishaps presents a viable

alternative. The movement to personal communications technology throughout the world could mimic the successful usage of cellular telephones, as the only means of effective communications, during the San Francisco earthquake.

One measure of the world's concern and its search for solutions has been through the establishment of the "International Decade for Natural Disaster Reduction."[1] Various high level councils and advisory committees, the UN and its agencies, the intergovernmental, nongovernmental and private voluntary organizations are meeting regularly to seek new and better ways to deal with disaster. The need to find new technologies which can survive both the forces of nature unleashed or those disasters assisted or produced by man-made means is paramount.

The concept of personal communications units distributed widely by satellite again surfaces as a technological solution. Currently these units only exist in limited regions of the world. Cellular expansion, dependent on terrestrial distribution, will be slow to reach parts of the world that are so often devastated by disaster.

The demand for information: more, better, accurate, reliable, timely, available and affordable, arises time and again in the deliberations of the UN and other agencies concerned with disaster communications. Various telecommunications systems have been examined: most existing systems are subject to vulnerabilities of size, survivability, affordability, portability and ease of use in a disaster situation; some require external power sources; some are too large to be quickly put in place; some need time-consuming governmental approval to be deployed and, in most instances in the developing world, they are too expensive to be stockpiled where they are most apt to be needed.

The Declaration of Tampere

An international group of experts in communications and disaster management, including key leaders from within the United Nations system, met for a global Conference on Disaster Communications in Tampere, Finland, in May of 1991. The Conference issued "The Tampere Declaration on Disaster Communications."[2] Among the major recommendations of that Declaration, which has been distributed throughout the UN system and to governments, intergovernmental organizations and nongovernmental organizations, worldwide, were:

> "...There is an urgent need to improve international cooperation in communications and enhance national communications capabilities in order to reduce loss of life, damage to property and livelihoods, and damage to

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[1]Resolution adopted by the General Assembly, A/RES/44/236, 20 March, 1990.

[2] The "Declaration of Tampere," produced by the Conference on Disaster Communications, Tampere, Finland, May 20-22, 1991. Convened by the United Nations Disaster Relief Organization (UNDRO), the International Telecommunications Union (ITU) and the International Institute of Communications (IIC).

the environment caused by disasters.

> "...The Tampere Conference stresses that improved flows of international information through telecommunication technologies, including satellite and broadcasting, can assist in the prediction, monitoring and early warning necessary to prevent some of the consequences and reduce the impact of such disasters once they have occurred. There is an urgent need to improve the nature, scope and quality of information being transmitted internationally, including its validity, significance, accuracy and timeliness."

Universal Network Access: The Future Technology

For years there have been dreams of a worldwide "personal communicator;" a highly portable, easily transportable, battery and/or solar-powered universal network access system; a device capable of connecting anyone, anywhere with anyone, anywhere.

There is one technology, close at hand, which meets the need. IRIDIUM, developed by Motorola, is a satellite-based communication system which can provide personal communications to meet the needs of the disaster assistance community. The system will provide handheld, pocket-size, subscriber units, for communications anywhere, at anytime and will be of special value for use in regions lacking standard or reliable telephone services, whether those services simply do not exist at all or whether conventional services have been rendered inoperative because of a disaster. The IRIDIUM system is scheduled to initiate service in 1996, with full operation planned for 1997.

The IRIDIUM System

The two critical elements of the IRIDIUM system are the space segment: a satellite constellation of 77 low-earth orbit satellites in seven different polar orbits, and the IRIDIUM user terminals which provide: two-way voice, data, facsimile, RadioDetermination Satellite Service (RDSS) positioning and location, and paging. These terminals are handheld and resemble ordinary telephones, similar to those in the now familiar cellular telephone systems. They are lightweight and battery-powered. For IRIDIUM, or any universal system to succeed, however, countries worldwide must agree on spectrum allocations for its use, to ensure that anyone anywhere in the world can reach anyone else in the world simply by dialing direct.

During the Loma Prieta earthquake in California, virtually all of the disaster-relief agencies noted that the disaster-assistance and relief effort was held together by cellular telephony.[3] The highly developed, fixed communications infrastructure did

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[3] "A Review of the Effectiveness of Communications During and Shortly After the Loma Prieta, California Earthquake."

not perform adequately. A system capable of providing global network access could easily tie into those cellular systems that survive the catastrophe as well as operate on its own, from handheld communicator to handheld communicator. It is anticipated that the IRIDIUM telephones will be in the hands of many private and institutional users worldwide. Additional units should be stockpiled by those charged with disaster relief and assistance, such as, in the developing countries, the United Nations Development Program's resident representatives.

The World Administrative Radio Conference

Industry recognizes the technology is available today, but there are challenges to make it come to fruition. If an IRIDIUM-like system is to achieve its full potential, action must be taken at a World Administrative Radio Conference (WARC) scheduled to take place, under the auspices of the International Telecommunication Union (a UN Agency) from the 3rd of February to the 3rd of March, 1992. A WARC allocates worldwide frequencies through a process of negotiation amongst all member countries of the ITU, a one country/one vote body.

Nations have the opportunity to choose. Does an IRIDIUM-like system represent the best use of these scarce frequencies? If decision-makers agree, they can influence their national governments' telecommunications policies and petition for telecommunications services that can serve the disaster community.

The timing is perfect. The International Decade for Natural Disaster Reduction mandates the use of technology for disaster relief. The technology is waiting, but it's not going to be easy: there is general agreement that the challenges are political, not technical. Will the countries represented at the WARC make the commitment to telecommunications technology that offers such great promise to disaster relief? Can the world wait for the next WARC to bring the issue of disaster communications to the negotiating table? Can the world afford to prolong human suffering?

The Experts' View

The community of disaster communications experts has made its needs clear. It did so as far back as 1979,[4] and as recent as at Tampere and other conferences.[5] [6]

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[4] "Application of Technology to Disaster Relief," by PSSC staff members Bert Cowlan and Lee M. Love, in "Disaster Assistance: Appraisal, Reform and New Approaches," New York University Press, 1979, a United Nations Association-USA Policy Studies Book.

[5] Convened by UNDRO and organized by the PSSC, held at the Palais des Nations, Geneva, Switzerland, March 19-21, 1990.

Now, it must press its case at other international venues. Disaster respects no national boundaries; it can strike anyone, anywhere, and at any time. Advanced communications technology may not prevent disasters, but can minimize the tyranny disasters impose upon the peoples of the world.

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[6] Symposium on Disaster Communications, convened by PSSC in conjunction with the State of California as part of earthquake awareness week, Ontario, California, April, 1990.

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(6) Symposium on Disaster Communications, convened by PSSC in conjunction with the State of California as part of earthquake awareness week, Ontario, California, April, 1990.

CONCURRENT RAINFALL RATE, BEACON AND TV CHANNEL ATTENUATION, AND SKY NOISE TEMPERATURE MEASUREMENTS IN PAPUA NEW GUINEA.

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1. ABSTRACT

A low cost, less complex system for measurement of propagation path attenuation of satellite signals in the Ku-band using standard equipment is reported. Propagation attenuation on AUSSAT beacon and TV channel 14 BMAC signals is measured against sky noise temperature and rainfall rate. The low level beacon at 12.74975 GHz carries PCM data on a phase modulated carrier with a peak deviation of 32KHz. The carrier remains constant for long periods but at unpredictable times during telemetry activities, the levels change. A second method designed to avoid this problem is used where the carrier is extracted from the FM BMAC signal on channel 14 which carries the Australian ABC television service at 12.629GHz. The third approach involves using a Ku-band radiometer to measure directly the expected transmission losses from the satellite by monitoring the sky noise temperature. This paper describes the experimental arrangement and presents some of the results obtained to date.

2. INTRODUCTION

Rain in the lower atmosphere is one of the major causes of signal loss on satellite transmission. Considerable work has been carried out in analysing this problem in the temperate regions (1). The CCIR and other slant-path propagation prediction models are well tested against temperate data accumulated over many years. In tropical regions, investigations have been much more limited. Based on only scant experimental data, there is some evidence these propagation models are not sufficiently accurate for regions of severe rainfall rates such as the tropics. In order to evaluate the theories and model-revisions that attempt to take account of tropical regions, it is necessary to have measurements from such regions. In recent years, a few tropical experiments (2) at Ku-band have been designed mostly using radiometers but also in some cases with beacon monitoring from a suitable satellite. However, this is one of only two experiments of this kind in existence in this region of the Pacific (2). Measurement data from this project will help rectify this data gap and provide results against which to test any propagation model proposed for the tropical regions.

It is desirable to make measurements in a range of elevation angles because the significant differences between tropical and temperate conditions relate to the size and number of individual raincells (3). For instance, at near vertical incidences during intense tropical rain, the entire beam may be filled by one raincell, giving maximum attenuation (1). However, beams at low elevation angles may pass through a number of cells, but because the horizontal extend of a cell is relatively small (1,4), it would be only partially filled, resulting in less signal attenuation.

It may not always be possible to choose a satellite with the preferred elevation angles, especially when other factors, such as a suitable beacon carrier frequency and EIRP are to be considered. It therefore becomes important, if the amount of tropical data available is to be increased rapidly for further Pacific installation that use should be made of satellites with less ideal signal formats, such as television or data carriers. This has been the approach at Lae in Papua New Guinea.

A second aspect of this kind of experimentation is that in many Pacific countries, there is a need to minimise costs and to avoid complexity. By using standard equipment where possible, by careful conditioning of the data before storing, through the use of well tried and popular software such as the Lotus spreadsheet, it is possible to meet these challenges.

This paper describes the design of the experiment,gives an outline of the spreadsheet software and presents results to date. It is hoped that the relative simplicity of the instrumentation and the minimal software development will encourage others to join in the gathering of this vital data on tropical propagation.

3. SYSTEM DESCRIPTION

Located 7 degrees South and 147 degrees East, Lae is classified as between the M and P zones (5) on the CCIR rain climatic regional map. The AUSSAT satellite is at 161 degrees East. The elevation angle from Lae to AUSSAT is 73 degrees. So far this is the highest elevation angle anywhere in the world. The monitoring station is looking almost straight up at the satellite and any rain affecting transmission will be directly overhead.

The satellite is not beamed directly at PNG and it's full strength received level is quite low. In order to achieve the highest possible signal to noise ratio two different techniques are used to measure the down link attenuation. The first method uses a beacon carrier in a bandwidth of 300Hz. The other uses the TV carrier in a bandwidth of 300KHz. These carriers have EIRPs of 0dBW and 31dBW, with corresponding C/N of 26.6dB and 27.6dB respectively. The methods are scalar in nature with no phase lock requirements so that the detection thresholds are effectively at the noise level.

In the first technique, the beacon signal is measured. It is much lower in level than the TV signal and requires very narrow band filtering in order to detect it at all. The beacon carries telemetry, selectable in four modes by ground control. In normal operation the common mode beacon frequency of 12.74975GHz is selected for continuous teleme-

try. This results in a constant carrier level when measured over all attainable integration times and allows the use of a narrow band filter (300Hz) to minimise noise. The nominal beacon received frequency has a regular +/- 30KHz variation and it's level is approximately 30dB down on that of the unmodulated video carrier. It is required to measure fades of up to 15dB and therefore a signal to noise ratio of at least this figure is necessary. In practice, a dynamic range of 20dB has been achieved. To achieve the required 20dB, the total sweep is no more than 10KHz, the spectrum analyser IF bandwidth 300Hz and the video bandwidth less than 10Hz. If the carrier varies due to modulation mode switching, it becomes necessary to extend the bandwidth to at least 100KHz to include the sidebands centred at +/- 32KHz. That would reduce the C/N power ratio at Lae to 1.37dB, against the minimum acceptable range of 10dB (by the Contractor, INTELSAT).

To measure the beacon carrier in a 300Hz bandwidth, the filter must track its frequency drift which is as much as 15KHz an hour due to local oscillator drift in the LNC. The commom mode beacon at the LNC output also shows a diurnal drift of about 0.5MHz. A Tektronic 2710 tracking spectrum analyser with a sweep time of 30 seconds holds the response of the drifting signal at the screen centre and updates the peak reading every sweep. During a deep fade when C/N is 0dB, the tracking assumes an "idle" mode and will resume tracking when the signal returns, provided the response has not in the meantime drifted off the screen. Fades are unlikely to exceed 10 minutes and since a one hour drift is almost 15KHz, tracking will be recovered even in worst fading, provided the sweep scan is about 10KHz. In practice it was found that during a storm the drift rate increases and tracking loss can occur. The analyser has a video output comprising a voltage which is proportional to the peak vertical deflection of the trace. This voltage, which is proportional to a reference level in dBm, is the one converted by the interface A/D in the BBC-B microcomputer.

Beacon measurement provides a reliable method of monitoring downlink attenuation, but there is always a possibility that carrier level may change due to modulation schedules. For this reason, and to increase reliability through redundancy, the second method of carrier detection in the TV channel runs concurrently with direct beacon measurements.

The second method involves monitoring the FM BMAC TV signal on channel 14 which carries the Australian ABCTV service at 12.629GHz. Because of the very low signal strength, detection thresholds, in the full FM bandwidth of 25MHz, are effectively at noise level. To reduce the effects of noise on the signal, measurements can be done only in a narrower bandwidth. To achieve this it must be certain that the signal will remain within the measurement channel while measurements are made. Tests on the BMAC signal have revealed that by making measurements only during a precise time interval of the frame synchronization period, the noise can be limited by filtering and yet be certain that there is a full power signal within the measured bandwidth. It was found that it is possible to recover accurately the peak pulse levels in an IF bandwidth of 300KHz. A Takada Riken spectrum analyser with a sweep time of 10 seconds is used to monitor continuously the TV signal strength in a narrow (300KHz) channel. At least one sample is taken per sweep. During the frame synchronization period, pulses of full power carrier level are detected and stored in a peak hold detector. This detector is updated every 10 seconds during the sweep. The output of the peak hold circuit is a DC level directly proportional to the received signal strength.

A third aspect of the experiment involves using a 11.6GHz COMSAT radiometer from INTELSAT under Contract INTEL-870, which directly measures the expected transmission losses from the satellite by monitoring the sky noise temperature. It is used as a backup and provides clear sky reference. Antenna temperature is sampled at the same rate as the beacon and TV channel to a resolution of 4 degrees Kelvin.

Propagation attenuation of the satellite beacon and TV signals is measured against rainfall rate and sky noise temperature.

The arrangement of the complete monitoring station is shown in Figure 1. The attenuation on the down link is monitored in 1dB intervals directly from the beacon and TV channel 14. As mentioned both the TV channel and beacon depend on conventional spectrum analysers with sweep times of 10 and 30 seconds respectively. The lower beacon rate is to reduce the amount of data collected whilst providing a level of backup redundancy against a channel breakdown or up link event. Two tipping bucket raingauges are used to measure rainfall rate. The gauges agree to within 5%. Pluviometer rainfall total for each month is compared with the accumulated recording of the bucket tips for the same month. They agree to within 6% but accuracy up to 10% is acceptable at high rainfall rates. No calibration correction has been done to the gauges because the maximum rainfall rate is about 200mm/hr which is their maximum rate of operation. Also, under the contract, INTELSAT requires 180mm/hr as the maximum in this work.

Data collection is done with a BBC-B microcomputer that has four resident A/D converters, an 8-bit parallel I/O port, and an RS432 serial interface to an IBM AT. The configuration and monitored ranges are as follows:

Beacon.....Clear sky (0dB) to -20dB, in 1dB steps: A/D 1.
Channel 14.....Clear sky (0dB) to -20dB, in 1dB steps: A/D 2.
Radiometer.....0 to 395K in 4K steps: (BCD) 8-bit USER port.
Raingauge 1.....0.5mm equivalent rainfall per tip: Port PB0.
Raingauge 2.....0.5mm equivalent rainfall per tip: Port PB1.

4. SOFTWARE

Simply making the measurements is only part of the experiment. The results of all three measurements, and the rainfall rate must be continually monitored and recorded. Computer software was specially developed to log all these measurements 24 hours a day and seven days a week. Under normal running conditions with no rain, a record is taken every 10 minutes with power and temperature levels compared to a 5 minute running average. (The 5 minute running average is done to reduce the data volume). If rain is detected through the tipping of a gauge or one of the power readings becomes different from the running average of power ratio by 1dB or more, the program automatically records the measurements every 10 seconds. The 10 second

sampling is usually considered the maximum for adequate event capture rate. It will continue recording at 10 second intervals until the reading becomes equal to the running average. Then it resumes recording every 10 minutes. A similar 5 minute running average on the radiometer output ensures that for a departure of 4 K from the average, recordings of all measurands revert to 10 second intervals.

Once data is collected by the logging computer, a further programme has been developed which transfers the data to an IBM AT for data processing and analysis using the LOTUS package.

5. RESULTS

5.1 10 Minute Data

Figure 2 shows an example of processed 10 minutes data. The 10 minute Beacon and TV Channel levels show a diurnal variation of the oder of +/- 1dB and this is superimposed on a longer term drift of 7-8 days. These results have been found by deleting all data from the record except that at the 10 minute intervals. A running average over 24 hours is then obtained and the 10 minute variations plotted relative to that. The effects of rain on the 10 minute data has been eliminated by replacing "rain damaged" 10 minute data with 10 minute data from the nearest quiet zone at the same time of day, e.g. 24 hours earlier. The 10 minute levels are then used as the zero reference for the calculation of event attenuations. This procedure is based on the assumption that the major part of those variations is due to satellite movement. Lae is at the edge of the beam pattern and the small daily satellite movements varies the strength of the signal monitored by a large amount due to the distance involved. The clear sky which is taken as reference is related to the 10 minute data. (However the true reference is obtained by adding the 10 minute and long term variation and then comparing with the radiometer. This is because the radiometer is the final check.)

There is sometimes a discontinuity in the 24 hour running average from week to week because the averaging in each block begins 12 hours into the data and ends 12 hours before the end. The first and last 12 hours appear constant on the longer term drift in Figure 2 because they are set equal to the start and finish average values respectively.

Most of the fluctuation details on the diurnal patterns are due to small rain cells occurring high up in the beam. The main problem here is that the beacon and the TV channel are always showing rain. Clear sky can not be seen and therefore establishing a reference becomes difficult. To overcome this, the radiometer data is used. The radiometer sky noise temperature measurement results are used to calculate the sky attenuation for attenuations less than 1.5dB. During an event the attenuation is greater than 1.5dB and clear sky reference is given by a linear interpolation between the -1.5dB levels at the edges of the event. The +/- 1.5dB is chosen because the diurnal variation is of the order of +/- 1.5dB and the small raincells high up in the beam, about +/- 1dB.

Figure 3 is another example which shows data recorded during the period of 3/3/91-10/3/91. It shows rain showers during the whole period. The longer term variations can also be observed.

5.2 Attenuation And Rainfall Exceedence

The event data is taken at 10 second intervals or at the rate of bucket tips. Otherwise under normal running conditions with no rain, a record is taken every 10 minutes, with signal and temperature levels compared to a 5 minute running average. If rain is detected or one of the results changes in level by 1dB or more, automatically, all parameters are recorded at 10 second intervals until the current reading equals the running average. This ensures that any fade greater than 1dB causes recordings at 10 second intervals.

Attenuation on the Beacon and TV Channel is derived by the difference from clear sky signal level and that during a rain event. For the radiometer, attenuation is obtained from the difference between the clear sky noise temperature and that during a rain event. Rain rate is found from the time between bucket tips. Figures 4 and 5 shows examples of monthly cumulative statistics on rainfall rate, beacon and TV channel attenuation calculated from the measurement data of February and March 1991. Attenuation and rainfall rate exceedence statistics for 9 months (Feb.-Oct.,1991) have been computed to date. These have been averaged for preliminary comparision with the 1 year CCIR model. This is done in Figure 6.

The raingauges agree well up to 135mm/hr. This is because gauge1 is adjusted for highest accuracy at low rainfall rates and gauge2 is most accurate at high rainfall rates. However, in practice, gauge2 is most reliable. Therefore the monthly rainfall rate data from gauge2 was used to compute the 9 month average rainfall rate exceedences statistic in Figure 6(b).

For attenuation exceedences, the TV channel is the most reliable because it is based on 10 second sampling on the spectrum analyser whereas the bandwidth limitations limit the beacon sampling to 30 second intervals. Therefore the 9 month average attenuation statistic in Figure 6(a) was obtained from the monthly TV Channel attenuation exceedences.

6. DISCUSSIONS

6.1 Event Data

The high angle of elevation ensure that most events cause the whole beam to be filled with rain. This is illustrated by Figure 7 which shows the TV Channel and rainfall rate. (The rain figures need to be multiplied by 10). The event in Figure 7 was recorded during stratiform rain conditions. It is interesting to note the degree of correlation in the fine details of the rainfall rate and TV Channel attenuation, and the overall coincidence of the patterns in these stratiform conditions as illustrated in Figure 7(b). This is an expanded section of the first part of Figure 7(a). The incidences of such coincidences is high at all times during "wet" stratiform conditions. Results to date do show the tendency for high rainfall and high attenuation to occur more frequently at night-time, whereas during the day time the tendency is for lighter rain and lower attenuation.

Figure 8 shows a typical example of convective "dry" season conditions. The nature of the rain is no longer stratiform and coincidence of attenuation and rainfall occurs only at the peaks. There are periods when rainfall occurs with no measured attenuation. This would prove that rain moves in columns. The rain gauges can therefore collect rain whilst most of the beam is free of rain. Alternatively, attenuation, usually low, will occur during periods when the rain gauges do not register. For part of the year, rain columns move from north to south across a beam that looks more or less north east. In PNG, it is possible to be in rain on one side of the road whilst the other side remains perfectly dry. It is therefore quite possible that most of the beam could be filled with rain whilst the raingauges collect no water.

6.2 Comparison of Exceedences with CCIR Model

When looking at Figure 6(a) it should be remembered the CCIR model gives good agreement with results from attenuation measurements taken over periods in excess of two years (7) whereas the data here refers to a period of only 9 months. The two model calculations use different slant path reduction factors. The improved model takes account of the effects of the high rainfall rate in the measurements (7) and shows good agreement with the measured results.

For rain rate exceedences, the measurements are compared with the CCIR regions M, N and P. None of these regional models gives good agreement with the measured results. There is a marked break in the slope at $R_{0.01}$, the rain intensity exceeded for 0.01 percent of the time. Again care must be exercised because $R_{0.01}$ refers to an average year and this is only a 9 month period. The break at $R_{0.01}$ has been found at other tropical sites and some coastal areas where large expanses of water or mountains are found (8). Lae is situated close to the sea and is surrounded by mountain ranges with heights up to 3,000-4,000 metres. Moupfouma has given an atlas of u values in a model for rainfall rate given by (8):

$$P(R \geq r) = \frac{a.\exp(-ur)}{r^b}$$

where $P(R \geq r)$ is the probability of the rain rate r exceeding any rain rate R and the constants a, b are found from the measured or estimated value of $R_{0.01}$.

Moupfouma states that higher values of u are sometimes required for $r > R_{0.01}$ and that these conditions are associated with mainly stratiform rainfall. In contrast, Lae has highly convective rainfall with rain column diameters considerably less than 4 km. The high elevation angle to the AUSSAT beacon has allowed single rain columns to be clearly distinguished. With $u = 0.35$ or 0.55 for rain exceedences less than or greater than $R_{0.01}$ respectively, the experimental results show good agreement with the Moupfouma model. The high rainfall rates, in excess of 150 mm/hr are not statistically significant, because there is only one event at 170mm/hr and at 200mm/hr respectively. This is evident by the horizontal line of exceedences in each case. As more data is collected, it is assumed that their mean level will approach the u_x curve. A second factor is that the tipping bucket rain gauges read about 10 percent low at the high rainfall rates. These considerations have been taken into account by adjusting the u_x curve to the upper rainfall limit of each event as represented by a horizontal line of data points.

The results of early propagation work at Lae have been reported by Harris and Milner (5). Average annual and worst monthly cumulative distribution of rain intensity were derived from pluviometer results collected over the period 1983-86. The annual average rainfall intensity distribution is shown in Figure 9 with the CCIR model and classification zones M and P. Some preliminary comparisons can be made with the Harris/Milner curve and that of Figure 6(b) which was obtained from this work. Although the curve in Figure 6(b) was calculated from only 9 months of data, it can be observed that there is agreement between the two curves for rain rates up to 90mm/hr. Above 90mm/hr the Harris/Milner curve drops off due to the limitations of their method (5). The curve in Figure 6(b) goes well up to 200mm/hr. However, as mentioned earlier, the high rainfall rates in axcess of 150 mm/hr are statistically insignificant. When the full year data becomes available, it is expected that Figure 6(b) will be refined and made more accurate.

7. CONCLUSION

An overview of the experimental work being carried out at Lae, Papua New Guinea, under Contract, INTEL-870, has been given together with results gathered over a period of 9 months. Until data from a full year of measurement becomes available, no substantive conclusions can be drawn from these results. However, the preliminary results do comfirm the findings of Harris and Milner which showed that PNG is between M and P zones on the CCIR rain climatic regional map.

The effect of tropical rainfall on signal propagation above 10GHz has been clearly demonstrated with preliminary attenuation figures from the beacon and TV receivers and radiometer.

The system and techniques described are not complex and could be reproduced anywhere. Standard equipment and well tried software are used to minimise cost. It is hoped that the relative simplicity of the instrumentation and the minimal software development will encourage others, especially in the Pacific, to join in the gathering of this vital data on tropical propagation.

8. ACKNOWLEDGEMENTS

The authors would like to acknowledge the support of Dr. J.E.Allnutt, of INTELSAT, under contract INTEL-870.

Thanks are also due to The Papua New Guinea University of Technology for permission and financial assistance which made the presentation and publication of this paper at the PTC'92 Conference possible.

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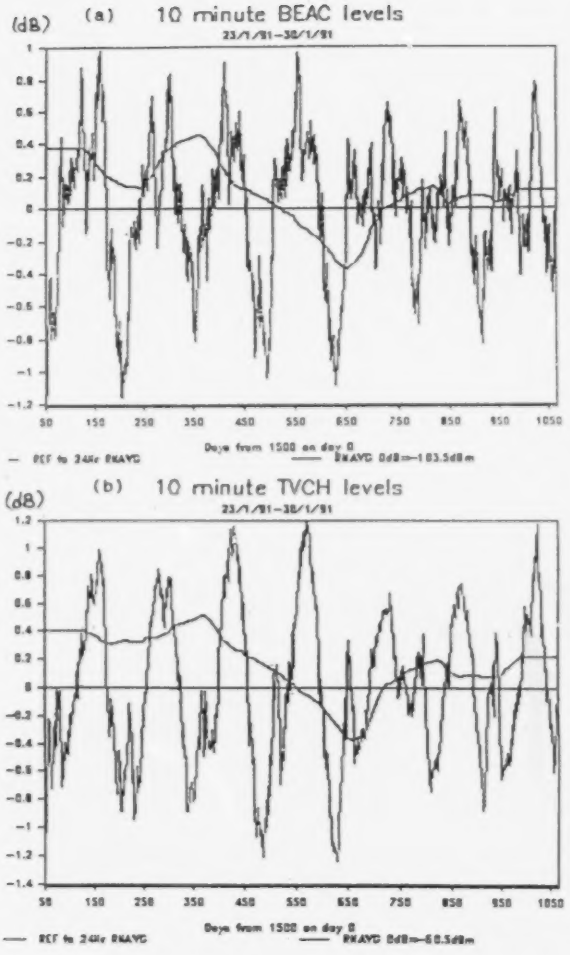


Figure 2 Example of processed 10 minute data showing diurnal variations and longer term drift.

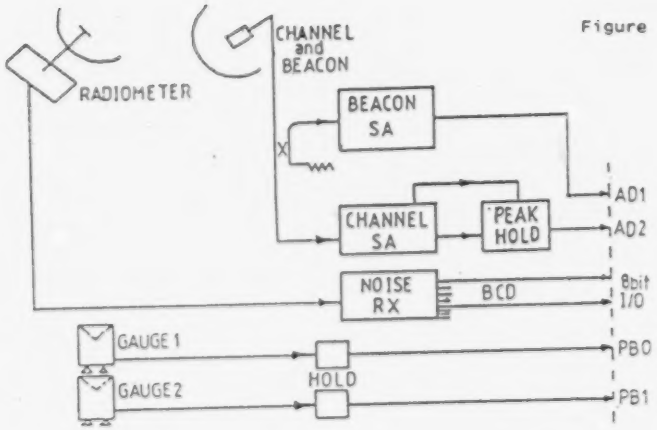
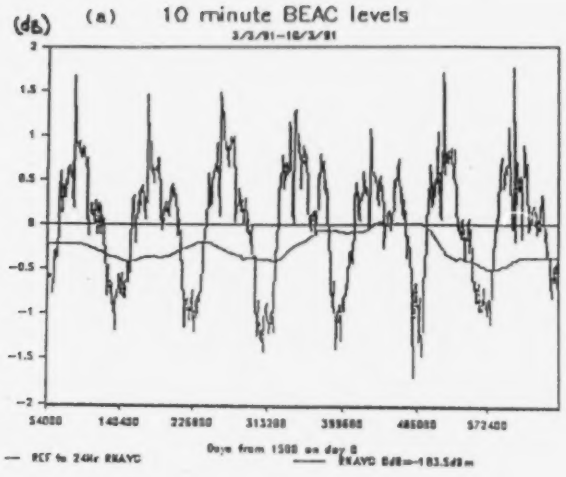
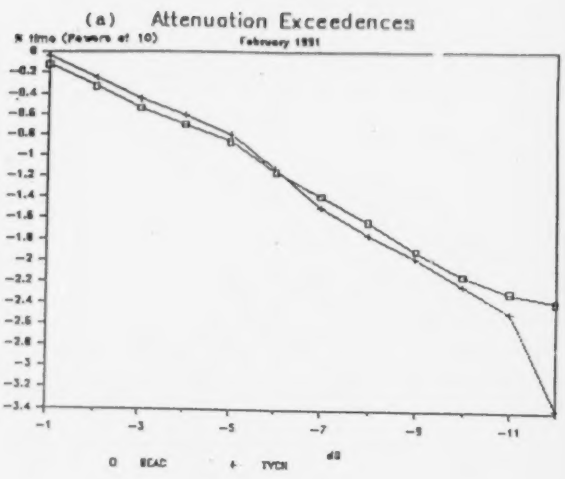
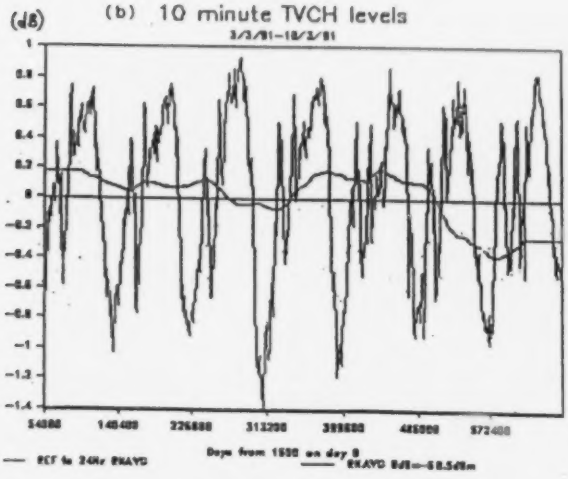


Figure 1 System Layout.







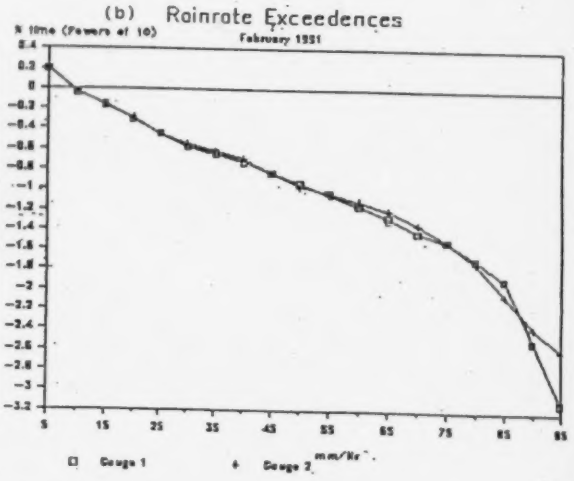
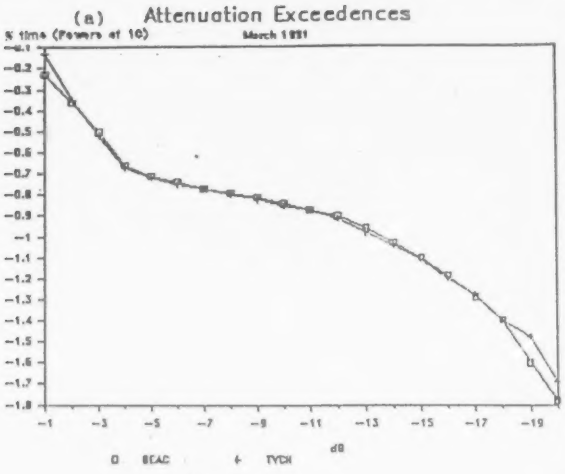
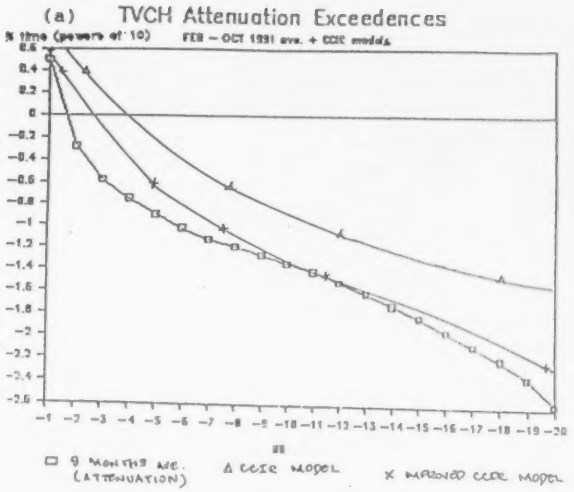
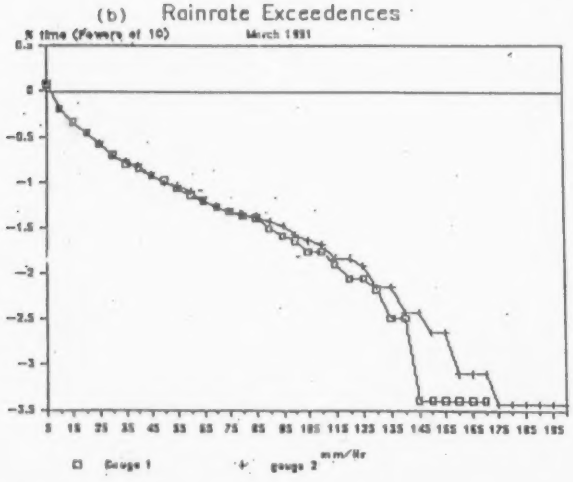


Figure 3 Example of processed 10 minute data showing diurnal variations and longer term drift.

Figure 4 Example of calculated average monthly attenuation and rainrate exceedences.







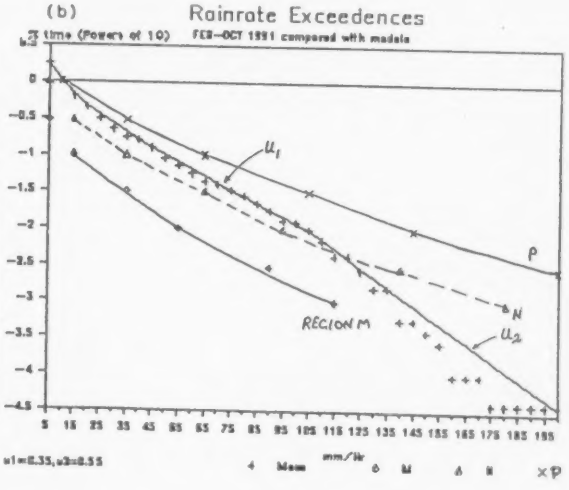
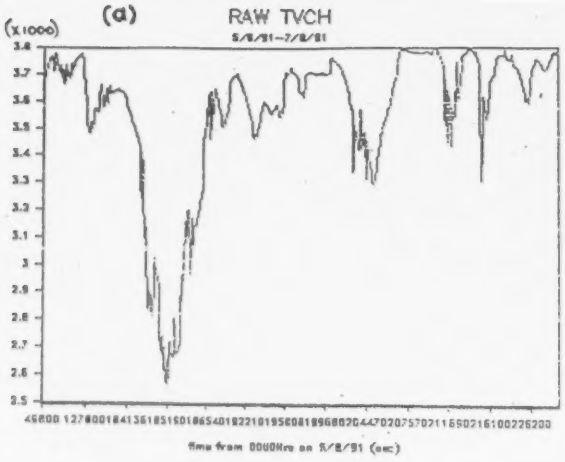


Figure 5 Example of calculated average monthly attenuation and rainrate exceedences.

Figure 6 Average 9 month attenuation and rainrate exceedences with CCIR models.



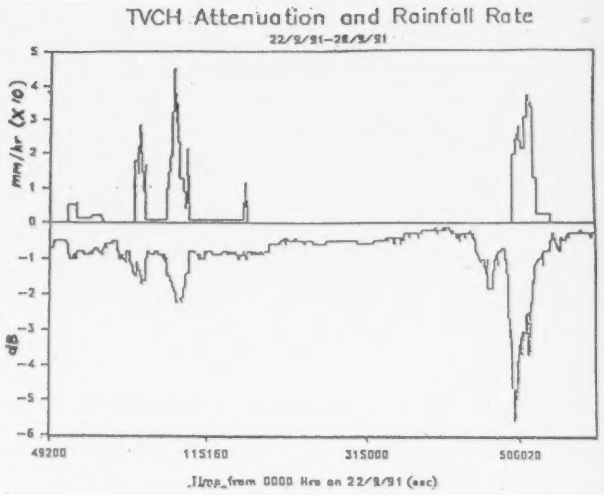


Figure 8 TV Channel and rainrate during a convective rain event.

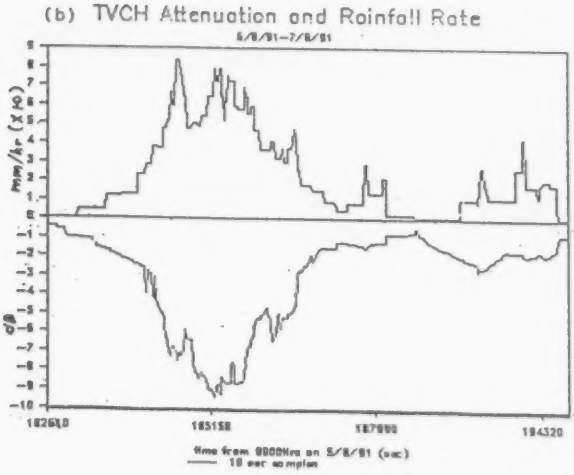


Figure 7 TV Channel and rainrate during a stratiform rain event.

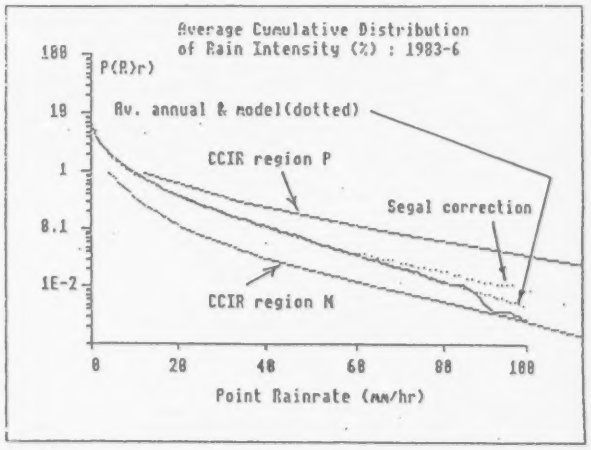


Figure 9

Average cumulative distribution of rain intensity from previous work at Lae by Harris and Milner (Ref. [5])

WARCs AND FUTURE ISSUES

R.E. Butler

WORLD ADMINISTRATIVE RADIO CONFERENCE (WARC) 92

WARC 92 is the first conference for a general review of parts of the Radio Frequency Table (Article 8) of the Treaty Force Radio Regulations appended to the International Telecommunication Convention since the very general World Administrative Radio Conference (WARC) 1979. Within the competence of its agenda, each WARC establishes a revised framework for internaitonal and national arrangements for the planning and use of the spectrum.

In brief, WARCs provide the basis of supreme tests of international co-operation. In particular, they provided the necessary recognition to enable industry, system designers, planners, manufacturers and service innovators to proceed with confidence towards cost effective production, service adaptation, innovation, investment and operation, along with the necessary user qualify. These assume particular importance in the current era of globalisation, the search for world-wide compatability, the most effective investment and efficient use of the spectrum, servicing adequately the interests of all nations.

The 1980s saw an unprecedented and intense conference programme initiated from the last general review of the radio spectrum and allocation table at WARC 79. Then the accent was not merely on technology developments since the preceding comparable conference of 1959, but also on the issues of equitable and appropriate, equal access, taking account of the relevant provisions of the International Telecommunication Convention and ever increasing service and policy needs. Thus, WARC 79 led to a whole series of specialised service conferences to open up, plan and use more effectively additional radio spectrum for particular service objectives, albeit for fixed, mobile, broadcasting including HF (shortwave) broadcasting and a variety of satellite services.

Those conferences of the 1980s completed their tasks with varying degrees of success, and some limitations became evident. They left unresolved accommodations of a number of service needs like, for example, for public correspondence to aircraft as well as appropriate spectrum to permit the proper evolution of a variety of mobile service needs and advanced quality video services. Then, too, there has been the need to review the technical and other aspects to permit the rational evolution of satellite sound (audio) broadcasting which was also raised initially at the WARC 79, but which for both technical and other reasons in the climate of the decade, has not been settled.

The last of such service conferences which prompted the need for WARC 92 was in 1988.

Since then technology, opportunities, service needs and the telecommunication environment have been advancing and changing rapidly.

Digitalisation is also bringing significant quality improvements, greater band widths, enhanced reliability and stability for low powered and low cost service applications with growing service convergence between wireless (radio) and wired systems. All of these developments can bring unprecedented possibilities of portability, mobility and personal user convenience. They bring opportunities for multi-purpose use of spectrum and faciliites, albeit for satellite or terrestrial operations.

Thus, we have the opportunity to enter into the era of tetherless communications in which handsets, stations, terminals and a host of new communication systems and devices can be linked together by wireless means (terrestrial and space) bringing comparable quality but greater flexibility than conventional wired connetivity of the past. The traditional dependence upon wired connectivity is being radically reduced. Choice, flexibility and appropriate cost alternatives through wireless connectivity are not only feasible, but also realities, both in local loops and in regional and global two-way interactive communications.

Personal communication networks (PCN) technology has also arrived. It necessitates the appropriate spectrum for both terrestrial and satellite means - the latter, in particular, through the advent of low earth orbitting satellites (LEOs) in which the conference has the obligation to establish the necessary basic spectrum parameters to permit the realisation of appropriate service design, system engineering, production and adaptation to enable investment and the like to proceed confidently. Of course, the use of LEOs for particular purposes has been tried during the decade and, like most space applications, used for other government/experimental means. There comes a time when adaptation should proceed for general service applications. The time is ripe for the recognition of such systems, knowing that they would operate with simple hand-held units/terminals/handsets where related to:

- either slow bit rate data transmission and collection, with telemetry (very important for future environmental mangement needs), or

- more up-market solutions with composite voice and data systems providing access-type possibilities to and between public and private networks.

The 1988 World Administrative Telegraph and Telephone Conference (WATTC), Melbourne was a landmark in establishing the first set of integrated internaitonal telecommunication regulations for integrated international telecommunication service and networks through the introduction of the necessary framework provisions (in contrast to detailed service regulations). It provided the foundation for implementing the "networks of the 90s" and beyond.

WARC 92 can well be the 1990's watershed for the future of the ITU in the radio spectrum sector, providing a major test of the Union's flexibility to meet on a global basis service needs, permitting more appropriate sharing and use of the spectrum, resources, the emerging service opportunities and innovative technology opportunities.

In today's globalisation, decisions must be taken with a world-wide application perspective. Many realise the significance of the importance of economies of scale, technology transfer and the avoidance of technical interference with current and planned uses of the spectrum in the long term perspective. We need to maximise the opportunity of portability and mobility, which now extend well beyond national borders and, indeed, regions. These are the important and growing prerequisites for achieving efficiency and seemless interactive connectivity with appropriate access with wired systems and networks, private an dpublic, on a multi-country basis, subject to the respect of national sovereignty and the like.

Thus, at WARC 92 there is the responsibility: not merely to review the results of previous conferences and the particular issues needing more spectrum or improvement in the effective use of the spectrum, albeit as examples for mobile or HF (shortwave) broadcasting services; but also accent in the decisions for more efficient use of the spectrum which necessitates a departure from traditional separations and would lead also to more efficient deployment of investment and the like. Some services have already been able to achieve much towards such objectives, as in the case of single side-band technology, digitalisation or improved planning arrangements in order to absorb certain of the expanded service demand sover the decade.

There is the need to provide the frameworks for the future, both in regard to emerging service growth and for global allocations like, for example, the variety of possibilities, including earth orbitting satellites (LEOs) because of the unprecedented opportunity they provide for access services to complement or integrate with both mobile and fixed service networks, including in the areas which are unreachable at present by the classical fixed/mobile cellular-type networks, etc.

Then too, in the case of audio satellite broadcasting, it will be important to realise the significance of the new quality transmission possibilities and, in some cases, the appropriate opportunities for many countries to leap frog traditional technology applications and to ensure nationwide quality service. The evolution of this technology application necessitates a more flexible approach to the planning and access to the geostationary orbit/spectrum than the existing radio regulatory provisions for the broadcasting satellite

service. On the other hand, it is important that the arrangements for the introduction of such a service do not bring the same difficulties as has occurred in certain other broadcasting services like HF (shortwave) broadcasting services over four decades or more.

Whilst the WARC 92 is not yet considering specific spectrum allocation for the growing extension of local area networks (LANS) using wireless technology, it is likely that portability will lead to the need for certain harmonisation of spectrum use for such purposes. They offer tremendous economic and social opportunities and trade-offs across the board from the campus and the classroom to the home and the workplace. Some identification of the emerging national applications of spectrum use for LANS with existing service bands will be useful.

All of these developments and enhancements are with us. How we enable their effective application and widespread availability through the ITU frameworks with benefits to all communities will depend on the visionary inputs and related co-operation for the long term perspectives to the preparations and decision making at WARC 92.

COMMUNICATIONS SATELLITES FOR THE PACIFIC ISLANDS

William Cooperman
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Abstract

The paper identifies twenty-nine current or proposed telecommunications satellite systems that have the potential of providing services for the Pacific region. Eighteen geostationary satellite systems and eleven non-geostationary systems are described and systems that may be relevant to telecommunications needs of the Pacific islands are noted.

National Telecommunications and Information Administration

U.S. Department of Commerce

Washington, D.C.
January 1992

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Communications Satellites For The Pacific Islands

INTRODUCTION

The Pacific island nations have long recognized the benefits that an efficient communications system could have on the economic and cultural well being of the region. Many studies and surveys have examined the potential for advancement of communications within the Pacific island nations. Especially relevant to the Pacific has been the advancement of satellite technology. With the vast amount of space between islands in the region and the general low density of population, satellite communications has been recognized as one of the most reliable and efficient technologies. Other prevalent technologies such as High Frequency radio (HF) serve a very useful function for the region. HF radio systems, however, have severe limitations concerning both reliability of service and the variety of services that can be offered.

INTELSAT, INMARSAT and PEACESAT have been three principal providers of satellite services for the Pacific island nations. These geostationary satellite systems have been able to offer full-disk footprints for the vast majority of the island nations and have provided services that have connected remote island communities to the rest of the world. Other providers such as AUSSAT and OTC International have been able to offer regional signals that provide useful services to island nations within the specific coverage patterns of their respective satellites.

Although satellites have been providing useful services for almost thirty years, the technology is far from stagnant. Recent advances will make possible the introduction of services that could only have been dreamed of just a generation ago. The Pacific islands may be able to take advantage of these new technologies in the next few years. Services such as rapid data transfers, inexpensive earth terminals and portable hand-held telephones are possible by the end of the decade. It is recognized that the ultimate cost of these services and the desires of the Pacific islanders to participate in the new services will be key to the adoption of advanced communications services; but a great potential exists in the near future.

The intent of this paper is to review current and proposed satellites that cover the Pacific island region. Each satellite has advantages and disadvantages depending on the specific needs of the user. Cost may be a factor in some proposals, coverage may be an issue in another proposal, and lack of a particular service may hinder the adoption of a particular satellite system. Some of the proposals could offer significant advantages such as economical infrastructures, availability of new services and cross-cultural or cross-island connections that are not now possible. It will be up to users to decide which service best fulfills their specific needs.

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The staff at NTIA decided that they needed to review all satellite systems that are either currently deployed or that are proposed for service to the Pacific to determine the feasibility of providing a long-term solution for PEACESAT. The purpose of this paper is to provide an overview of the current potential for satellite telecommunications in the Pacific without analyzing specific service needs. It is recognized that the Pacific islanders have various communications needs and that no one technology or satellite system can serve all those needs. It is also recognized that a combination of technology including high-frequency radio transmissions (short-wave), undersea cables[1], ground-based telephony service, large-scale telephony satellite services, and thin-route low-cost satellite systems are all appropriate for various uses in the Pacific island region.

Satellite Study

A detailed review of commercial satellite activity concluded that there are twenty-nine proposed satellite systems which could provide service to the Pacific region. These proposals include both geostationary and non-geostationary systems. However, the vast majority of the satellites currently in existence or proposed for the future, do not focus on the needs of the Pacific islands *per se*. While the Pacific islands may be within the footprint of a proposed satellite system, the main focus of service is usually on those nations along the Pacific Rim which are highly industrialized or which have very large populations. The vast spaces across the Pacific islands and the general sparsity of population do not usually make the Pacific islands an economic attraction to many telecommunications satellite system service providers.

This paper reviews each of the 29 current and proposed satellite systems which have the potential to serve the Pacific region. Information for this study has been obtained either directly from the system sponsors, through official filings at the U.S. Federal Communications Commission (FCC) or at the International Frequency Registration Board (IFRB) of the International Telecommunication Union.[2]

The review is divided into four sections:

Section A	An overview of projects using geostationary satellites.
Section B	An overview of systems that propose to use non-geostationary satellites employing low-earth orbits, high orbits or highly elliptical-orbits.
Section C	Detailed descriptions of eighteen geostationary satellite systems.
Section D	Detailed descriptions of eleven systems that have been proposed using low-earth, high or high elliptical-orbit satellites.

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SECTION A

Overview of Geostationary Satellite Projects

Geostationary satellites reviewed are located above the equator between 150° West longitude and 140° East longitude and have the potential to provide service to all the major Pacific island communities.[4] Satellites located within this arc can be viewed by earth terminals from anywhere in the Pacific islands. The satellites located directly east of this arc are domestic satellites serving the United States. West of this arc are satellites providing, or planning to provide, domestic or regional service to the Asian countries. These satellite systems, including ASIASAT, PALAPA, CHINASAT, INSAT, and the proposed THAISAT, KOREASAT and MEASAT systems, are located too far west to provide service to the Pacific Island Nations but are more fully described in the appendix.

INTELSAT is an international telecommunications satellite consortium that has the mission to provide worldwide service including the Pacific Ocean region. Through the use of global footprint pattern satellites, INTELSAT is able to provide coverage for the Pacific islands. Unfortunately, satellite technology needed to produce a global footprint required the use of very large and expensive earth stations. INTELSAT service has been valuable in providing worldwide coverage and coverage has become widespread. INTELSAT, however, has a stated policy that all users will pay fair market prices for services. Due to the relatively low economic activity in the Pacific islands, this policy does not allow many of the Pacific island nations to acquire more than one earth terminal for each country. The outer islands are limited to other communications technologies such as HF radio which do not have the same capacity, capability or reliability as satellite communications. INTELSAT is planning to assist the Pacific islands in the future with the launch of two INTELSAT VII series satellites over the Pacific in 1993 and 1994. The new satellites are designed to provide more signal power which will allow for much smaller and more affordable earth terminals. The support of very small aperture satellite (VSAT) technology by INTELSAT VII satellites should encourage the island communities to acquire more earth terminals for expanded telecommunications.

Another major provider of satellite services for the Pacific Ocean region has been the INMARSAT Organization. The INMARSAT system carries ship-to-shore and ship-to-ship services for the maritime community. Recently, however, the Organization adopted policies allowing it to provide mobile service to land-based individuals, including those in the Pacific. For instance, INMARSAT has made a specific commitment to the 70 residents of Pitcairn Island to provide telephone-like service to that island. INMARSAT, through its recently announced Project 21, is considering other low-cost mobile services, but it is not clear at this time what the availability

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The other four satellite services currently offered in the Pacific region are: AUSSAT A-3, COLUMBIA-TDRSS, STATSIONAR, and PACT. The AUSSAT A-3 satellite provides a footprint to the South Pacific and covers the Solomon islands, Fiji, Tonga, America Samoa, Western Samoa, Vanuatu, New Caledonia, the Cook Islands, Tuvalu and Nauru. Services provided include television, single-carrier-per-channel (SCPC) voice channels and data. The South Pacific service on the AUSSAT A-3 satellite is operating at full capacity and no further space is available. The COLUMBIA-TDRSS is a new satellite intended to provide coverage to the North Pacific and will offer voice, data, and video. COLUMBIA-TDRSS is not intended at this time to be connected to the Public Switched Telephone Network (PSTN). The STATSIONAR system consists of Russian satellites that include global coverage beams. Due to the political environment in the former Soviet Union, the current status of STATSIONAR service in the Pacific region is unknown. The last satellite system currently providing service is the Pacific Area Cooperative Telecommunications (PACT) system which is operated by OTC International and uses capacity on an INTELSAT satellite. PACT provides voice, facsimile and in-band data services to the Cook Islands, Nauru, Niue, Marshall Islands, Tuvalu, and Kiribati.

Our review also found 11 proposed geostationary satellite systems. Some of these satellite proposals call for more than one satellite in orbit. The following satellites propose voice, data and video services: ASIA-PACIFIC, PACSTAR, PACIFICOM, PANAMSAT, TONGASAT, and UNICOM. ASIASPACE is proposing a global coverage pattern for direct audio broadcasting. SAT/TRACS is proposing a global footprint for data, positioning and short messages. COLUMBIASAT is proposing a satellite where both the footprint and services are to be determined. FINANSAT has proposed transmitting primarily digital data among the United States, Asia and Australia. The Russian EXPRESS satellites will have a global footprint, but has not specified services.[5]

Eleven systems have been identified. ARIES, GLOBALSTAR, ELLIPSO, IRIDIUM, and ODYSSEY will offer voice, data and radiodetermination satellite service (RDSS). STARNET and ORBCOMM will offer data, short message services and RDSS. LEOSAT is a proposal for data transmission from "smart" cars. VITASAT is proposing a data service specifically for health and education uses in developing countries. GONETS is a digital data, electronic-mail, store-and-forward service provider. INMARSAT'S Project 21 is exploring the possible combination of low-earth, medium orbit and geostationary satellites into a single system to provide world-wide telecommunications.

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Global Coverage Beams - Operating

SATELLITE INFORMATION	COVERAGE	CURRENT SERVICE	STATUS
GEOSTATIONARY @ 177.5°E (INMARSAT II) @ 180° E (INTELSAT)	GLOBAL	Maritime and mobile service with data, facsimile and voice transmissions	Operational

INMARSAT

INMARSAT offers global coverage and has historically utilized a combination of INTELSAT capacity and its own satellites to provide worldwide coverage. INMARSAT launched a new satellite to serve the Pacific in December 1991. This satellite, INMARSAT II (F3) will replace the MARECS-A satellite which had provided Pacific service along with an INTELSAT satellite located at 180° E. INMARSAT has announced plans to offer two new communications services in the 1990's that may be of use to the Pacific islands. INMARSAT B service will provide higher facsimile rates but utilize less bandwidth and result in lower toll charges. It is mainly intended for maritime use. INMARSAT M service will also use less bandwidth and provide digital voice-coding techniques, but will use very portable, less expensive earth terminals the size of a briefcase. The type of INMARSAT services that are offered to ships at sea could become attractive to some islands in the future as costs decrease.

Although INMARSAT has typically been a provider of maritime services, it has expanded in recent years to provide mobile services. The technology used by INMARSAT has been relatively expensive, but with the adoption of new techniques it can be expected that the cost of services should decrease.

INMARSAT has also made a commitment to the tiny island of Pitcairn to provide its sole international telecommunications satellite service and may offer similar services to others in the future.

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terminals in six Pacific island nations (the Cook Islands, Kiribati, Marshall Islands, Nauru, Niue and Tuvalu), as well as sites in Australia and New Zealand. PACT is a Demand Assignment Multiple Access (DAMA) system using a global beam on INTELSAT's 174° E satellite. The system uses earth terminals varying in size from 4.5 meters to 30 meters to transmit switched voice, fax and in-band data. The PACT system will expand to fifteen terminals in 1992, with four additional terminals scheduled for the Cook Islands and one additional terminal in Kiribati. OTCI also hopes to expand the PACT communication services to include data network service, teleconferencing and a broadcast service. Under the PACT system, all users share satellite channels on a demand assigned basis. Access to the satellite is controlled from OTCI in Sydney, Australia, but OTCI cannot monitor phone calls. The Australian government and OTCI granted A$3.3 million for the upgrade of Pacific island hub terminals to utilize the PACT system. The PACT system provides for domestic service from outer islands at a tariff of A$.05 per minute, regional calls to other countries within the PACT network for A$.40 per minute and calls outside the PACT network at A$.20 per minute.

SATELLITE INFORMATION	COVERAGE	CURRENT SERVICE	STATUS
GEOSTATIONARY GOES-3 satellite 175° W S-band L-band	Global coverage	voice, data, facsimile; slow scan video; non-commercial use only	Operational in over 20 Pacific Island Nations

PEACESAT

The Pan-Pacific Education and Communication Experiments by Satellite (PEACESAT) program currently uses the NOAA GOES-3 satellite to distribute non-commercial communications, such as educational, medical and environmental programming, to over 20 Pacific island nations. The GOES system operates S-band and L-band frequencies different from those used by the other geostationary satellites.[6] Voice and data communications services are supported by the system, and include teleconferencing from multi-sites, data distribution, remote database access, facsimile and slow scan video. The system uses 3 meter antennas and earth terminals have a single transmit channel capability. PEACESAT is operated by the University of Hawaii and the satellite is supplied by the U.S. Department of Commerce at no cost to the Pacific Island users. The GOES-3 satellite is located at 175° W longitude and is expected to be in service through the end of 1994.

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY To be determined	GLOBAL	Direct Audio Broadcast	No application on file yet.

ASIASPACE

Worldspace, Inc. has proposed a series of satellites to provide direct audio broadcasts to developing areas, including Africa, Asia and South America. The U.S. Federal Communications Commission has given Worldspace, Inc. an experimental license for the construction of a satellite to serve Africa, to be known as AFRISPACE. Contracts have been signed with International Technologies, Inc. for the construction of the satellite and a control center in the United States. It is Worldspace's plan to provide direct audio broadcasts on 36 channels in the L-band, with S-band broadcasts also possible. Receiving radios, known as Starmans, will cost approximately $50-100 each, use a very small (credit card size) antenna and can be solar powered. The satellite will be launched in late 1994 or early 1995 by China's Great Wall Industry. Contracts have been signed with several users for program distribution on AFRISPACE. ASIASPACE is planned to follow activation of AFRISPACE.

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 140° E, 155° W, 145° E	GLOBAL	Not specified	Advance notice to IFRB

EXPRESS

The Russian government has recently provided IFRB notice of a new 13 satellite system called EXPRESS. Each EXPRESS satellite will have a transponder which provides global coverage. Express 10 will be located at 140° E, EXPRESS 11 at 145°E, and EXPRESS 12 at 155° W, where it will provide coverage from eastern Russia to the middle of the United States. Each satellite will have global coverage in the C and Ku bands, though not on the same frequencies as used by Western commercial satellites.

transponders which can use the South Pacific Beam are fully booked and no capacity is available for additional services. The A-1 and A-2 satellites do not have a similar South Pacific beam; the B-1 and B-2 satellites scheduled to replace them in 1993 and 1994 also do not have a South Pacific beam. The AUSSAT A-3 satellite is expected to be in service until 1997.

South Pacific Coverage beams - Proposed

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 172° E	South Pacific	Voice, data, video	Application pending before FCC; no IFRB Publication

PACIFICOM

TRW's Space and Technology Group has applied to operate a satellite at 172° E with a second satellite planned to be collocated there as demand warrants. PACIFICOM proposes Ku-band U.S. gateway services between the western continental United States and selected Asian nations and C-band services between western North America and the nations of the South Pacific (including Australia and New Zealand) and Asia as well as foreign domestic and foreign regional satellite services. Specific services include Ku-band video and HDTV, data and voice networks, private computer networks, and video teleconferencing. C-band services include commercial television collection and distribution, and high speed data. PACIFICOM proposes to sell or lease capacity on a non-common carrier basis. At this time, TRW anticipates that a significant portion of the capacity will be sold or leased for international communications originating or terminating in the U.S. not interconnected to the public switched telephone network. The balance will be used by foreign domestic or foreign regional services desirous of relatively inexpensive capacity. Launch is proposed for 1994.

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 167.45 ° E	South Pacific beam in addition to ASEAN beam	Voice, data, video	IFRB registration

PACSTAR

Pacific Satellite Inc. proposes to launch two satellites, PACSTAR-1 to be located at 167.45°E and PACSTAR-2 at 175°W. PACSTAR-1 will have a combination of C-band and Ku-band

from Guam in the Northwest to American Samoa in the Southeast covering all islands in between) and the U.S. beam (west coast, Hawaii, southern Alaska). Ku-Band coverage is similar except that there is no Pacific beam.

PANAMSAT intends to offer a full range of services including:

Video	full and reduced bandwidth analog video, wideband high definition video and audio, satellite news gathering, compressed video, cross strapped video between areas. Broadcast quality television could be available with antennas as small as 4.6 meters (or even smaller in the C-Band spot beams).
Audio	SCPC-FM 15 kHz audio, SCPC-FM 7.5 kHz audio, subcarrier audio, digital audio.
Telephony	60 channel FDM/FM, 360 channel FDM/FM
VSAT	using hub stations and TDM/TDMA modulation. Could also be mesh configuration.
Spread Spectrum	Five MHz of the spacecraft bandwidth would be devoted to one-way and two-way data broadcast.

The FCC has granted PANAMSAT a waiver to begin construction in order to meet a projected launch date in the second quarter of 1994.

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 83.3° E, 130° E, 134° E, 142.5° E	Multiple spot beams, areas not specified	Voice, data, video	IFRB Registered; two locations sold to Unicom

TONGASAT

The Friendly Island Satellite Communications, Ltd., operator of TONGASAT, has six orbital slots registered with the IFRB, located at 83.3° E, 130° E, 134° E, 138° E, 142.5° E and 170.75° E. (This is reduced from the original TONGASAT proposal of 31 orbital slots.) TONGASAT has already agreed that Unicom Satellite Corporation will be able to place satellites at two of the orbital locations with the potential of UNICOM occupying all six slots (see UNICOM below). In addition to its agreement with UNICOM, Friendly Island is proceeding with the development of the TONGASAT satellite project. TONGASAT intends to provide C-and Ku-band service using global, regional and spot beams to provide for telephone, video conferencing, high speed data transfer and home TV reception. The TONGASAT system is intended to provide high power levels to the Pacific (38.9 dbw) which will support direct interconnection using 2-3

Unspecified Coverage or No Service Proposed to Pacific Islands

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 165° W	to be determined	To be determined	Being held pending completion of TDRSS project

COLUMBIASAT

Columbia Communications, operator of the Columbia-TDRSS systems, has a conditional authorization for a satellite proposed for 165°W. After completing implementation of service on the TDRSS satellites, Columbia intends to provide additional service in the Pacific using the COLUMBIASAT satellite. The original COLUMBIASAT coverage area included service among the United States, Japan, Hawaii and Alaska. Final design of the satellite, including coverage areas and number/type of transponders, has been delayed as Columbia has concentrated on acquiring and marketing the C-band transponders on the TDRSS satellites.

SYSTEM TYPE	COVERAGE	SERVICE	STATUS
GEOSTATIONARY @ 178° W	US, Far East, Australia; No Pacific island coverage proposed	Primarily digital data for corporation use	Conditional FCC authorization; IFRB coordination completed 3/91

FINANSAT

The Financial Satellite Corporation was granted a conditional authorization by the FCC in 1986 for a Pacific Ocean Region satellite at 178° W and an on-ground spare. FINANSAT intends to offer transponders for sale or lease primarily to financial and other business institutions on a non-common carrier basis. Each satellite would carry 24 C-Band transponders with 36 MHZ bandwidth. The FINANSAT Pacific satellite would have three beams directed at the western U.S., the Far East, and Australia. FINANSAT plans to support point-to-multipoint communications to receive only terminals at customer premises as small as 18 - 24 inches in diameter and transmit/receive service to terminals approximately three by five feet. FINANSAT believes its major market is to provide customized intracorporate digital data network operations primarily to banks and other financial institutions with many international locations. The company is currently seeking financing for its proposed system.

SECTION D

Low-Earth Orbit and Other Non-Geostationary Satellites

In the past two years, several organizations have proposed constructing systems of low-earth orbiting satellites or other non-geostationary satellites to provide telecommunications services. Low-earth orbiting satellites usually orbit at a height ranging between 400 to 800 miles, much closer to the earth than the 22,500 mile high location of geostationary satellites. The earth terminals used with the low-earth orbiting satellites require relatively little power, can be very small and can be easily transported. It is anticipated that earth terminals could be hand-held units the size of mobile radios and range in price from $200 to $2,000.

Since the satellites in these systems will be very close to the earth, each satellite will only cover a small portion of the earth's surface. Many satellites will, therefore, be required for a system that provides worldwide coverage. However, even a single low-earth orbit satellite in polar orbit will pass over the earth twice a day, even if service to that area is not intended. Low-earth orbit systems therefore have the potential of providing service to the Pacific basin, whether or not the Pacific is the intended service area.

Two types of systems have been proposed, systems using VHF frequencies or those which use the L-band frequencies.

- VHF based systems are designed to support only data transmission. Systems included in this category (GONETS, LEOSAT, ORBCOMM, STARNET, and VITASAT) are low-earth orbiting systems.

- L-band based systems are designed to support voice communications as well as data transmission. Systems included in this category (ARIES, GLOBALSTAR, and IRIDIUM) are low-earth orbiting systems.

  The ELLIPSO system proposes satellites in highly elliptical orbits.

  The ODYSSEY system will use satellites in high-orbit, approximately 10,239 km above the earth.

  INMARSAT has announced that it is considering a system which could combine geostationary, low-earth orbiting and/or high elliptical orbit satellites in a single system.

partners are Defense Systems (which has built more than 20 microsats for the U.S. Department of Defense), Microsat (which is developing the Orbital Express launch system for small satellites) and Pacific Communications (which developed specifications for Aussat's MSS system). User terminals are expected to cost about $1,500.

TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
Highly Elliptical Orbit	24 Satellites 63° inclination 2903 Km apogee 426 Km perigee	Voice and data, RDSS	1610-1626.5 (U) 2483.5-2500 (D)	NA

ELLIPSO

Ellipsat Corporation has filed for a 24 satellite system that will use elliptical orbits to provide voice mail, RDSS and interconnection to terrestrial cellular services. Each satellite will weigh 175 Kg and will be in an orbit with an apogee 2903 Km and a perigee of 426 Km. Four orbits with six satellites in each orbit will be required for global coverage, though Ellipsat intends to start service for just the United States using nine satellites. The system plans to use 1610-1626.5 Mhz for uplinks, and 2483.5-2500 MHz for downlinks, with no C-band or intrasatellite links. ELLIPSO hand units will be available for satellite access. Add-on units will also be available to add ELLIPSO RF electronics to existing terrestrial cellular systems. The targeted user cost will approximate cellular system pricing, or about $.60 minute.

TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
Low	48 Satellites 52° inclination 1389 Km high	Voice and data, RDSS	Plan A: 1610-1626.5 (U & D) See Note	C-band

Note: Globalstar has three alternative frequency plans. Plan B uses L-band for uplink, S-band downlink and C-band feeder links to gateways. Plan C uses L-band bidirectional to users and S-band bidirectional to gateways. (Plan A uses C-band feeder links between the satellite and the gateways.)

GLOBALSTAR

Loral Cellular Systems is a partnership between Loral Aerospace, a satellite manufacturer, and Qualcomm, a provider of two-way mobile satellite communications systems and digital cellular

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the development of the IRIDIUM system. User terminals are projected to cost between $3,000 for a full system down to $200-$300 for a paging or RDSS only unit. The IRIDIUM system is targeted at high-end users who can pay a usage charge of approximately $3 per minute. Motorola recently purchased the licenses for operating on the 1610-1626.5 MHz frequencies from the bankrupt Geostar Corporation and is asking the Federal Communications Commission to transfer the licenses from Geostar to Motorola.

TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
Combination of types	To be determined	To be determined	To be determined	To be determined

INMARSAT PROJECT 21

INMARSAT has announced its "Project 21," which intends to provide INMARSAT service into the 21st century. Currently, Project 21 is not a firm proposal, but is an announcement of interest by INMARSAT. The goal of Project 21 is to provide global voice services to hand-held terminals by the end of the decade. These hand-held voice terminals would interface with terrestrial cellular systems. Targeted costs for the terminal would be $1,000 (US) with less than one dollar a minute for service charges. INMARSAT has indicated that it will consider using a combination of geostationary satellites as well as low-earth orbiting, or high earth orbit satellites. The INMARSAT Board of Governors has not endorsed the Project 21 concept, but has authorized INMARSAT to do technical research in this area.

TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
High	12 Satellites 55° inclination 10,239 Km high	Voice and data, RDSS	1610-1626.5 (U) 2483.5-2500 (D)	Ku-band

ODYSSEY

TRW's ODYSSEY system will consist of 12 satellites in medium earth orbit, 5,600 nautical miles above the earth. The ODYSSEY system will provide voice, data and RDSS service and is designed to complement terrestrial cellular service. Four satellites will be in each of three planes inclined at 55°, and will orbit the earth once every 6 hours. Each satellite will have 19 spot beams and will be visible over the user's terminal for 1.5 hours. The system proposes to use the

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TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
Low	18 Satellites 40° inclination 970 Km high	Data from smart cars	148-149 (U) 137-138 (D)	NA

LEOSAT

LEOSAT Corporation has proposed a satellite system that will provide "smart car" low speed two-way data transmission, primarily from automobiles and trucks. Transmitters could be integrated into automobile components, fixed transmitters would be used for monitoring, and personal portable units could be used for individual use. Individual radios could cost less than $200. Contact time between a user terminal and the satellite system would be less than 16 minutes. The LEOSAT system would initially consist of two satellites, primarily to serve the United States. A world-wide system would eventually require 18 satellites. Satellites would be manufactured by DSI Microsat and placed in an orbit 970 Km above the earth, inclined at 40°. The system proposes to operate on the 148-149 MHz and 137-138 Mhz bands. LEOSAT has signed an agreement with Canadian Satellite Corporation to cooperate on implementing LEOSAT technology in Canada.

TYPE	SATELLITE CONFIGURATION	PROPOSED SERVICE	PROPOSED USER FREQUENCIES (MHz)	SATELLITE-GATEWAY LINKS
Low	20 Satellites 18 in 40°-60° inclination 2 in polar orbit	Data, short messages, RDSS	148-149.9 (U) 137-138 (D)	NA

ORBCOMM

Orbital Science's ORBCOMM system envisions 18 satellites with six satellites per plane, inclined at 40°-60°. An additional two satellites would be in a polar orbit to serve the North and South polar regions. ORBCOMM satellites would provide very short (no more than 30 characters) two-way data packets compatible with the X.25 packet protocol. Orbital Science also manufactures satellites and satellite launchers, and would construct the ORBCOMM satellites and launch them on its Pegasus launcher. The ORBCOMM system proposes to operate on the 148-149 MHz and 137-138 Mhz bands and also would have a 400 Mhz downlink to provide time and positioning information. Estimated cost of user terminals range from $50 for a basic terminal to $150 for

frequency plan uses 400.15-401 Mhz uplink, 137-138 Mhz downlink, and is compatible with the ORBCOMM FDMA system. The other frequency plan is to use 148-149.9 Mhz uplink, 400.15-401 Mhz downlink in order to be compatible with a spread spectrum system as proposed by Starsys. VITA currently is operating a prototype system using the UoSAT-3 low-earth satellite designed by the University of Surrey, England. This system is providing health, energy, and educational communications services to sites in Africa. The UoSAT system permits the transmission of from 50 to 250 pages of text twice a day. The next generation VITASAT will have the capacity of transmitting up to 350 pages of text. VITASAT is currently experimenting with terrestrial packet radio network telecommunications in developing countries which could be linked with VITASAT. Fixed and portable terminal assemblies will be manufactured by VITA and are expected to be sold for $5-7,000.

Endnotes

1. While many consider undersea submarine cables as alternatives to satellite communications, submarine cables across the Pacific have as their primary use the exchange of international traffic between the Americas and Asia. Submarine cables have and will continue to bypass the small island nations of the Pacific basin. A recent worldwide study of almost 500 submarine cables indicates that only four Pacific islands are connected by submarine cable: Hawaii, Guam, Fiji, and Papua New Guinea (Port Moresby). None of the current submarine cable projects under development, including the North Pacific Cable, TASMAN 2, TPC 4, Asia Pacific Cable, PacRim East, and TPC 5 will provide new service to unserved Pacific islands. *1990 World's Submarine Telephone Cable Systems,* NTIA-CR-91-42, October 1991.

2. The authors would like to acknowledge the assistance of the many individuals and satellite organizations who provided information for this study and to the staffs at the FCC and NTIA for their assistance in this project. Special thanks are due Charles Rush, Hal Kimball and Craig Moll of NTIA for their thoughtful guidance in the preparation of this paper.

3. For example, the PEACESAT system uses a GOES meteorological satellite system that has been modified for voice and data communications use.

4. For example, a satellite located at 150° West longitude would require an elevation angle of less than 6° above the horizon for an earth terminal in Belau. Likewise, a satellite located at 140° East longitude would require an elevation angle of 10° above the horizon for an earth terminal in French Polynesia.

5. After the breakup of the former Soviet Union, the Russian Republic assumed control of the Ministry of Communications and appears to be in control of the Soviet space program. Therefore, we have adopted the convention of referring to the satellite systems and activities of the former Soviet Union in this paper as Russian.

6. The terms S-band, L-band, C-band, Ku-band and Ka-band are commonly used to refer to general satellite frequencies. In common usage, frequencies in the L-band are in the 1500-1600 Mhz range, S-band frequencies around 2500 Mhz, C-band in the 3/6 Ghz range, Ku-band in the 10/14 Ghz area and Ka-band in the 18/30 Ghz range. However, the specific frequencies utilized will vary in different countries or areas of the world.

constructed by Hughes based on its H-376 satellite and launched in 1994 by Arianespace. The Malaysian partner is Bina Riang Pte. Ltd. The Philippine Long Distance Co. is one of six users signed up for the project. Malaysia has not started IFRB coordination for orbital locations for Measat.

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Spinning New Legal and Regulatory Webs for Telecommunications Services in the Pacific: IVANS, Trade Agreements and the Uruguay Round

by

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Pacific Telecommunications Council '92
Honolulu, Hawaii
January 15, 1992

I. Introduction: Development of a Multi-tier Legal and Regulatory Regime for the Telecommunications Services Sector

The theme of this Fourteenth Annual Conference of the Pacific Telecommunications Council focuses on telecommunications integration in the Pacific. The challenge, of course, is how to integrate while disintegration -- the emergence of competition within and between countries -- is more the order of the day. When the colonial powers controlled the provision of telecommunications services in the region, the web of interlocking relationships almost defined the concept of integration. Not much changed when governments, nationally-owned PTTs, or private monopolies assumed responsibility for the provision of services in the region.

Now, in some sense preceding or perhaps mirroring the transformation of the world's geopolitical order -- the disintegration of the East Bloc and the Soviet Union, the emergence of democratic regimes around the globe, a recasting of military and economic alliances -- is a transformation of the telecommunications sector. As we have heard throughout the PTC, monopoly is being replaced by competition, privatization efforts are well advanced, countries are lining up to position themselves as regional, if not international, hubs. Each country has come to understand that technologically advanced and economically competitive telecommunications services are critical to broader economic growth. Industry is attracted by high-quality, efficient and low-cost telecommunications services. With the customer having a greater role in directing the evolution of sector, the traditional monopolistic approach no longer has either vitality or viability.

Paralleling this remarkable transformation is an extraordinary metamorphosis in the rules of

the game. As we all know, historically international telecommunications services were provided -- some would say jointly provided -- by two monopolists that had a correspondent relationship. Beyond the contractual arrangements that constituted the legal framework for that relationship, there was little else in the way of law or regulation that structured the relations between two providers of international services. To be sure, there was some government involvement in oversight of a PTT's operations. The ITU always played the most important -- and critical -- technical role in achieving global interconnectivity and establishing principles, in the form of recommendations, to guide international providers.

Today, however, with the transformation of the sector we have an entirely new set of rules. The days of a sleepy, predictable legal regime -- like that of an essentially public utility approach to the provision of telecommunications -- are forever behind us. As a lawyer, I know this all too well. What we are witnessing is not just bounty for the legal profession, but the creation of a set of principles -- and innovative approaches toward the establishment of such principles -- that will guide international providers into the next century.

What I have in mind, of course, is the development of a multi-tier legal and regulatory regime in which governments and customers are as much players as traditional carriers. What I have in mind is an overlay on top of traditional correspondent relations. What I have in mind are 1) the new bilateral arrangements for the provision of international value-added network services ("IVANS"); 2) informal government-to-government consultations on telecommunications issues; 3) regional arrangements, including those of the European Community, the incipient North American Free Trade Area ("NAFTA") and the Asia-Pacific Economic Cooperation ("APEC") grouping, about which much has already been heard at this conference; and 4) of course, multilateral arrangements, particularly those that may (in our lifetime) emerge from the Uruguay Round. I'd like to talk about each of these developments in the Asia-Pacific context.

II. New Bilateral Arrangements for IVANS

The extraordinary amount of effort that has been put in establishing new arrangements for the provision of IVANS -- and the popularity and success of such efforts for providers of value-added services and users -- is well known to telecommunications "groupies." Given the novelty of these arrangements and

the importance that have had for regional trade and economic growth and integration, it is, at least for me, curiously that they seem to have -- by and large, and with a few notable exceptions -- escaped the focused attention of academics, legal scholars and political scientists.

I will not canvass in detail the IVANS agreements that have been reached globally or in the Pacific region except to note that their genesis was in this part of the world. That is not at all startling -- given the innovative thinking that has characterized both economic growth and the provision of telecommunications services in the Asia-Pacific, it should surprise no one that new arrangements started here, as well.

The purpose of IVANS arrangements, of course, is to permit the offering of value-added services internationally. They are intended to remove regulatory and technical obstacles to service provision and to mitigate or overcome discontinuities in national regulatory schemes. They are concerned with a host of isssues that have kept lawyers, service providers, users and government officials busy for years: the absence or presence of any requirements that a provider of IVANS interconnect with other such providers; whether government approval of operating agreements is required; whether and how providers of IVANS are licensed; the use of proprietary protocols in the offering of a service; and the pricing of underlying telecommunications services, including whether they can or should be priced on a volume-sensitive basis.

From the standpoint of policy-makers in this region, the provision of IVANS has provoked fundamental questions about the structure or arrangements by which telecommunications services are provided:

> Which services should be provided competitively and how are such services related to, or may be substitutes for, services that have been reserved to a monopoly?
>
> What is the impact of the provision of end-to-end services on the "jointly provided" model?
>
> Do IVANS increase use of network services by stimulating demand or do they wreak economic harm by encouraging bypass of the public switched network?
>
> And, perhaps most importantly, how should those administrations that supply the network be compensated by those who use it to provide IVANS?

At a more concrete level, as government officials, users, and carriers attempt to work out bilateral arrangements to facilitate the provision of IVANS they confront another set of questions. First, who will or may provide IVANS? Monopolists? Carriers? National providers of value-added or enhanced

services? A joint venture established to offer IVANS on an end-to-end basis? Users or others not generally regarded as being in the telecommunications business?

Second, how will IVANS be provided? From abroad or from a third country? On an end-to-end basis or on a jointly-provided basis? Via leased lines or on a switched or dial-up basis? Will the leased lines be provided over a network separate from a network of leased lines that previously had been used solely for intracorporate purposes?

Third, to whom will IVANS be provided? To the general public? To a particular industry sector? To members of a closed user group? To entities with which the IVANS provider has a business, contractual or corporate relationship?

Fourth, what services will providers of IVANS be permitted to offer? The full range of services that may be provided competitively in one, or both, of the countries entering into the agreement? Services set out on a detailed list or, rather, described more generally? All services but those that might cut too deeply into the revenues or traffic stream of the monopoly or established carriers?

Some of the most innovative approaches toward thinking about and answering these questions has been in this region, stimulated by officials from the United States, from Japan, from Hong Kong, the Republic of Korea and other countries. Let me make just a few observations.

First, in these bilateral arrangements, the "lowest common denominator" -- that is, the least liberal regulatory regime -- will prevail. One country usually will be reserving on, for example, the inclusion of a particular service in an IVANS arrangement to accommodate its more restrictive regulatory framework.

Second, the IVANS arrangements may, in some cases, reflect the fluidity in the sector: they establish a process by which the parties can review progress under the arrangement and attempt to seek greater liberalization in the future. This process can be regularized in the form of an annual review, it can be more informal, or it can be directed toward specific issues left outstanding by the negotiations.

Third, there are various types or models of arrangements, which can be illustrated by way of the various IVANS arrangements that the United States has with a few countries in Asia. The U.S.-Japan IVANS arrangement -- the very first in the world -- emerged from trade negotiations. It is highly detailed;

the negotiations were protracted; the arrangement grew in stages and has often been revisited, rewritten and recodified. I suspect that that will continue for the foreseeable future.

The issues on which the negotiators focused were far-reaching, raising each of the questions that I posed above. They included such difficult matters as defining intracorporate communications, and shared or joint use. Importantly, at least from the standpoint of regional integration, the U.S.-Japan arrangement contains a provision that addresses whether there is a need to conclude arrangements with third countries, for services traveling beyond, or being routed through, Japan.

Nonetheless, although the U.S.-Japan IVANS arrangement has done much to facilitate the offering of services between the two countries, it is far from perfect. The Japanese, for example, are not altogether persuaded that traffic coming from Japan, being routed through and processed in the United States, and then sent on to a third country, falls within the scope of the arrangement. This position, if it were to prevails, would seem inconsistent with the intent of the arrangement and would have serious consequences, in my view, for the extraterritorial exercise of jurisdiction by the Japanese to traffic beyond their borders.

After its initial agreement with the United States, Japan then rushed ahead to negotiate an IVANS arrangement with the United Kingdom. The U.S. had been trying to do so for some time, and within a few months after the Japan-U.K. arrangement, also concluded one with the United Kingdom. In some sense, the U.S.-U.K. arrangement is at the other end of the spectrum from that of the U.S.-Japan agreement in terms of simplicity, approach and scope. It is, in essence, not much more than a simple exchange of letters that says "what is permitted domestically is also permitted between our two countries."

The U.K.-Japan arrangement is somewhere in the middle -- but much closer to the U.S.-U.K. end of the spectrum. That arrangement is important, moreover, because it serves as a paradigm for many of the other arrangements in this part of the world. In particular, the Japan-U.K. arrangement contains a list of permitted services, which was not true of the U.S. agreements with either Japan or the U.K., which either excluded certain services or made reference to the domestic regimes, respectively.

The U.S.-Hong Kong agreement, for example, which was concluded about one year ago, was, in this respect, modeled to a certain extent on both the U.S. and the Japanese arrangements with the United

Kingdom. The U.S.-Hong Kong arrangement is relatively simple -- a couple of pages, plus an annex that lists the services that are "value-added." It was negotiated rather quickly, and also contains a provision for reviewing whether certain services should be included within the arrangement.

Japan has been pursuing IVANS arrangements in the Asia-Pacific region very aggressively. In the last year or so, it entered into an arrangement with Canada. It has been discussing such arrangements with Hong Kong and Australia for some time. It is anticipated that these are or will be similar to the arrangement with the United Kingdom.

Last summer, the United States also concluded an IVANS arrangement with the Republic of Korea. Much like the agreement with Japan, this arrangement also emerged from trade negotiations between the two countries. The arrangement is simple and straightforward, based on a model proffered by the Koreans. In the eyes of many, this arrangement is clearly intended to be transitional, pending the conclusion -- about one month from today -- of more comprehensive trade talks between the United States and Korea on market access in the telecommunications sector. And, after concluding an agreement with the United States, Korea did so with Japan.

With the strongest interest and support of the U.S. private sector, the U.S. Government continues to pursue arrangements to facilitate the provision of IVANS services both outside and within the region. U.S. industry sees substantial benefits from these arrangements. Between the United States and Japan, for example, almost twenty companies have IVANS licenses (under Japanese law). The new services are seen as good for industry in both countries. The arrangements increase traffic. They promote arrangements between and with other countries. They are the forum for a dialogue to remove barriers and to develop a common threshold of what constitutes an acceptable level of regulation for IVANS.

Specifically, U.S. industry is particularly keen on arrangements with Australia and Taiwan. In some situations even an exchange of letters stating that there is no obstacle to the provision of IVANS between the two countries, or letters along the lines of the U.S.-U.K. agreement, would suffice. It is fair to say that, having had a taste of a new legal regime for the provision of international services, at least U.S. businesses are eager for more, for a web of arrangements spanning the Pacific, and the globe.

We could find ourselves "hung up" on whether these arrangements are "trade" agreements or are more technical agreements to clarify the terms by which IVANS can be provided between any two (or more) countries. In the long run, the taxonomy matters less than that they are concluded and that they achieve their intended results.

III. Bilateral Consultations

Beyond the more formal discussions between countries that are intended to conclude in a document -- in an IVANS arrangement or agreement -- governments are now talking or consulting on telecommunications matters of mutual concern. These consultations may be no more than fact-finding discussions, or an informal exchange of views between government officials, or between private sector delegations. They have occurred, by way of example, between the United States and Taiwan, the United States and Singapore, and between Japan and Australia.

These discussions, whether exclusively at a governmental level, or with the involvement and participation of representatives from the private sector, are entirely complementary to the discussions that have taken place with regard to the offering of IVANS. They may even lead to IVANS agreements.

The portfolio of issues raised in these consultations can be far broader, however. They can be targeted at what are perceived as specific barriers -- such as volume-sensitive pricing -- or equipment attachment policies. They can be the forum for rendering advice on the corporatization of a telecommunications administration or on a new national telecommunications law. What is important, here, is that countries are talking at multiple levels. They are engaged in trying to achieve an "interconnectivity" of regulation to facilitate the provision of services internationally.

IV. NAFTA

Hudson Janisch has already given an excellent paper on the U.S.-Canada Free Trade Agreement ("FTA"), which presages the NAFTA. Although it is commonly thought that the NAFTA discussions are of concern principally to "The Americas," all three countries -- Canada, the United States and Mexico -- are, of course, very much countries of the Pacific Region. Moreover, the development of a free trade area in North America will have significant implications for the rest of the region, both in its own right

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and as a potential example -- or model -- of further regional agreements in the Americas and elsewhere in the region. And, to be candid, a NAFTA would be seen as a constructive "fall back" if the Uruguay Round ultimately fails.

The NAFTA discussions that are currently ongoing are intended to build upon -- and expand -- the Canada-U.S. FTA. That bilateral agreement, of course, only addresses the so-called "enhanced services" side of the telecommunications services sector. It took a surprisingly long time to negotiate, especially given that the two countries have very similar regulatory structures and concepts.

What the two countries define as "basic" services were specifically excluded from the FTA. Why? To protect domestic markets and, at least from the standpoint of the United States, to achieve some equity or fairness in the relationship. U.S. negotiators asked why the U.S. basic services market should be frozen open for the Canadians, when the Canadian market was not as open for the Americans?

This exclusion, I should point out parenthetically, is not without problems. There continue to be controversies, for example, over the routing of intra-Canadian or Canada-third country traffic through the lower-cost service providers of the far-more-competitive United States. This practice has been the subject of a decision last year by the Canadian Radio-television and Telecommunications Commission ("CRTC"). The CRTC issued a ruling that is intended to prohibit Canadian users from sending traffic through the United States, even where that might make sense from the standpoint of network architectures or cost. Inevitably, despite the purported exclusion of basic services from the FTA, this issue will be put squarely on the table for discussion between the two countries in the context of the NAFTA.

All this, however, is for today's discussion a precursor of what is promised for the NAFTA. The highest possible priority -- as you all know -- has been put on concluding the NAFTA discussions quickly and with the greatest possible benefits for all three countries. In the NAFTA discussions, all three parties have agreed that telecommunications services are of very high priority indeed. A separate working group for telecommunications issues has been established. Discussion papers and, now, draft texts have been exchanged. Recently, a consolidated paper was prepared by the negotiators. This document is a major step forward in the negotiations because it reflects a consensus view that the NAFTA arrangement should set out the

conditions for access to and use of telecommunications services.

To be sure, there are differences among the parties with regard to range of issues. The Mexicans have put on the table for discussion a list of the telecommunications barriers in their own market. They have, as well, identified barriers in the other markets, including that of the United States.

The texts that are being reviewed and negotiated build on the principles of market access that have been developed and fleshed out in the Uruguay Round. I will turn to these in a few minutes.

Again demonstrating the extent to which the development of an international telecommunications regime is no longer entirely the closed club that it once was, the private sectors from all three countries have been deeply and intimately involved in the NAFTA process. They have assisted in the identification of barriers in the other markets. They have advised their governments on what to seek -- and what to protect -- in the exercise of removing barriers. They have met -- and continue to meet -- with their private sector counterparts, to exchange views and to try to establish a common position on what would be desirable for the telecommunications segment of the NAFTA.

A monumentally critical issue is the extent to which "basic" services are "on the table" for discussion. Although, as mentioned, they were not part of the FTA, the Mexicans have not foreclosed the possibility that basic services would be included in the NAFTA. (They would insist, of course, that the monopoly on long distance telephone services that Telefonos de Mexico has until 1997 not be disturbed by market access in basic services.) The U.S. private sector, even including some of the carriers, seems to be much more willing to have basic services be part of the NAFTA negotiations than, for example, part of the Uruguay Round.

In this regard, for the first time, the private sector has laid out the various criteria for affording Mexicans and Canadians access to the U.S. basic services market on the basis of equity and reciprocity. In the eyes of the private sector, at least, meaningful market access on the part of the Canadians or Mexicans would include:

1) the ability to build, own and operate networks and services;

2) ensuring that new entrants are able to enter into interconnection and access arrangements with the incumbent provider of services on nondiscriminatory terms and conditions and at a

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price that is cost-based and under transparent processes;

3) that access charges, if any, be cost-based;

4) refraining from imposing conditions on licenses to provide "basic" services, such as the obligation to provide local services;

5) implementing and enforcing strict safeguards that prevent the incumbent from cross-subsidizing between competitive and non-competitive businesses;

6) adhering to fair terms and conditions for billing and for the termination of traffic;

7) requiring that there be non-discriminatory and cost-based access to all network services features, functions and capabilities of the incumbent provider; and

8) an equivalence in the level of interconnect and access charges among the three countries so that the opportunities to compete are economically comparable.

As I will note briefly below, the U.S., as part of the Uruguay Round, has tabled five principles that would, when satisfied, constitute openness in basic long-distance services. When the other "major telecommunications markets" bind themselves to these principles, then the U.S. would be prepared to grant full most-favored-nation treatment to such services.

For the NAFTA, these principles may signal the terms and conditions, which, if met by the Mexicans and Canadians, would frame the environment in which the U.S. would bind itself to market access and full national treatment. The U.S. will continue to insist on reciprocity in basic services. Whether the Canadians or the Mexicans will be willing to go along is still very much an open question, however.

Should there be market access for the provision of basic services among the three countries, it will be the most integrated region -- from a telecommunications perspective -- in the world. Ahead of Western Europe, which has drawn the line for market access at the provision of infrastructure and public switched telephony and telex. Nowhere else in the Asia-Pacific region (with the exception of the New Zealand regime and the position that that country has taken on the issue in the Uruguay Round negotiations) is there talk of permitting unlimited market access to a nation's market for basic telecommunications services.

Thus, for the rest of the region, a successful conclusion to the NAFTA may well be an historic and potentially very significant watershed. It will signal that it is possible to create a free trade area among disparate economies, including the sector in which we are most interested. It will pose a challenge to other

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trading blocs in the region. And, to the extent that telecommunications is the foundation for broader economic expansion, what will be the impact of the integrating influence of the telecommunications services component of the NAFTA on the competitiveness of other countries and subregional or regional units?

The thrust for market access, openness and competition in the telecommunications sector, ultimately to include basic telecommunications services, comes from the widespread realization that telecommunications is an extraordinarily important vehicle for regional growth, facilitating cross-border trade and economic integration. This is the understanding of participants in the NAFTA negotiations at all levels -- governmental and private sector.

At least from this private sector perspective, the NAFTA negotiations have been encouraging. Negotiators are making what looks to be real progress. They are engaged on the issues. There appears to be a genuine feeling of cooperation, coupled with firmness on points of principle. Substantial and formidable barriers are being discussed and, we hope, toppled.

V. A Long Time A'Coming or Will it be Worth the Wait?: The Uruguay Round

Finally, then, to turn to the longest running act around: the Uruguay Round. Will there be an agreement or not? The telecommunications component of the negotiations in the Group of Negotiations on Services ("GNS") is irrelevant for purposes of answering this question. Thus, all of what follows (like all that has gone on for the past four or five years) is as likely to be overtaken by events as not.

The real issue for cognoscenti of telecommunications and trade in services is whether all the time and resources, of governments and private sector advisors and interested parties, that has been put into crafting the telecommunications-specific provisions of the Uruguay Round has been worth the effort. It is too early to render definitive views on that question -- but, at the risk of being unduly provocative, I will venture some observations.

A. Structure of the Services Elements of the Uruguay Round

Let us briefly review the structure of the services elements of the Uruguay Round negotiations. The GNS has been negotiating a framework agreement on services, to culminate in a General Agreement on Trade in Services ("GATS"). The GATS will have has two fundamental operating principles.

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First, certain general obligations and disciplines apply to all services -- including telecommunications -- of a party (unless a party has taken a specific derogation thereto). Second, specific commitments, including market access and national treatment, are accorded all providers of services listed on "schedules" of a party.

Thus, the general principles of the GATS would apply to telecommunications services, as a sector, and to any of its sub-sectors, including the provision of value-added services. These principles include such important obligations as according service suppliers most-favored-nation ("MFN") treatment, ensuring transparency in laws and regulations applicable to such services, committing that domestic regulation (where specific sectoral commitments are undetaken) does not constitute a barrier to trade and is applied in a "reasonable, objective and impartial manner," and preventing monopolies from abusing their position when supplying services for which specific commitments have been made and that are outside the scope of their monopolies.

The most powerful principles would apply to a particular service sector only where a party has specifically -- and as a result of negotiations with other parties -- committed to doing so. The principle of market access, where applicable, would bar countries from limiting the number of service providers in a sector or from imposing any other restrictive measures (including foreign ownership limits) on foreign service suppliers. The national treatment principle prohibits discrimination in favor of a national service provider and against a foreign supplier. Additional commitments may be negotiated.

Much, then, turns on whether telecommunications services are listed on a country's schedule of commitments. Beyond the spare text of the framework agreement, therefore, the essence of the GNS negotiations is at the second layer: identifying and negotiating away barriers to market access on a sectoral basis. These negotiations, which are both protracted and intensely political, require negotiators to identify specific barriers and then engage in "horse trading" with their trading partners. Country A will agree to liberalize on value-added services, for example, in exchange for Country B's commitment to liberalize in that, or some other, sector or sub-sector. Other than the brute force of political pressure and the articulation of specific interests by industry, it is difficult to imagine how these sectors are evaluated -- and valued as to the opportunities that market access might present to foreign suppliers -- for purposes of this exercise.

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Countries have tabled some of their "offers" in the request/offer process that I have described. Three more rounds of the process are anticipated -- now extending through early March. To date, developed countries have, by and large, made offers for meaningful commitments in the telecommunications sector, particularly with respect to value-added services. Some developing countries have as well, in some cases conditioned by licensing or other restrictions. As the negotiations move forward, there are reasonable prospects for improving these offers, or convincing countries to put value-added services on their schedule of commitments.

The third tier of the GNS structure is the much talked-about "annex on telecommunications." There have been innumerable iterations of this annex and one cannot begin to chronicle the twists and permutations throughout its nearly two-year old life. The justification for an annex relies on the definition of "measures by Parties affecting trade in services" that appears in the very first sentence of the very first article of the draft GATS. Such "measures" would include measures with respect to "the access to and use of, in connection with the supply of a service, . . . public telecommunications transport networks and services." The latest draft of the annex states that it has the "objective of elaborating upon the provisions" of the framework agreement with respect to such measures. In short, the annex, then, is intended to put some meat on the bare bones of what is meant by service suppliers having access to and use of public telecommunications networks and services.

There always has been some uncertainty as to how the annex is meant to dovetail with the scheduled commitments of a party. The question, in some sense, is whether the annex was (or is) intended to be liberalizing in its own right, or whether liberalization, in the form of market access, only can come through negotiated commitments for particular service sectors.

The U.S. initially had hoped that the annex would be a powerful force for liberalization, on its own, supplementing and complementing the scheduled commitments as to which the annex applies. In fact, although there are some liberalizing elements in the annex, its basic utility in that regard has been, over time, rather diminished.

The GNS working group on the telecom annex has been chaired by Bob Tritt, of Canada.

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Those negotiating the annex have kept their eye on the ball: to deliver services within a country, or on a cross-border basis, requires that service suppliers have access to -- and are able to use -- the telecommunications networks and services of companies that are, by and large, monopolies or exclusive providers of service.

The telecom annex could apply to all would-be suppliers of services to a country. Therefore, it is not restricted only to service suppliers in the telecommunications sector, but to all entities using telecommunications services. To trigger the application of the annex, however, a country must list the service on its schedule of commitments. In other words, without a party committing to market access, a would-be supplier of a service cannot claim the rights and privileges of the annex.

Allow me to turn to two controversial, telecommunications-related issues that have been raised in the Uruguay Round negotiations. They are: 1) coverage of "basic" telecommunications services and 2) the need for or value of the telecommunications annex.

B. Whither "Basic" Services?

First, as most GATT aficionados well know, the issue of whether "basic" telecommunications services should be included within the GNS negotiations and, if so, on what terms, has been the subject of the fiercest controversy, one that has even made its way into the general press. The issue is whether, on the one hand, parties, in the GNS agreement, should commit to keeping open markets that are now competitive or, on the other hand, they should be permitted to exclude from the obligations of the framework agreement one of their own competitive sectors when other countries do not provide equivalent market access. The sector we are talking about, of course, is principally the U.S. basic services sector.

In general terms, there is probably more interest on the part of users in having basic services covered by the GNS than there has been or is on the part of carriers. U.S. domestic carriers in particular, with the concurrence of some in the U.S. Government, have been concerned that the U.S. should not freeze its basic services market open (by entering into the GNS) while that market is closed in virtually all of the trading partners of the United States. Only a few countries have, even to a limited extent, put basic services on the table. In this part of the world, two countries have done so, one conditionally.

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The decision of the U.S. to take a derogation from the MFN principle for basic services, therefore, met with considerable resistance and outcry, both from within and outside the United States. For many it was, at least, a conceptual stmbling block to the successful conclusion of the negotiations on the GATS.

In response to other countries, the U.S. has, as noted, above, tabled a proposal that is, in part, intended to break an impasse on telecommunications in the Uruguay Round. The U.S. would commit to extend MFN to both domestic and international long distance services, on the condition that the major trading partners would agree to open their own long distance telephone markets to international competition. The challenge to the "major telecommunications markets" is to meet the liberalizing conditions set by the United States within three years after entry into the force of the GATS, or January 1, 1996, whichever comes first.

Frankly, this conditional commitment by the United States has met with some degree of skepticism by other countries and by some in our own private sector. Given the conditions -- and the fact that all major markets would have to commit to them -- it is very unlikely that the challenge set by the United States could be met. In other words, to many observers it seems virtually certain that the U.S. derogation from MFN for basic services will remain in effect. Indeed, a country other than the United States has little incentive to open its market -- for purposes of trying to gain entry into the U.S. market -- unless the other major countries do so as well. The net result may well be one that could have been foreseen: other countries will now take derogations from MFN for their own basic services sector.

C. The Telecom Annex

Turning to the telecom annex, the current draft -- which is nearly final -- reflects a balance between users and regulators. The U.S. private sector had gone into the Uruguay Round hoping that the annex would be a Magna Carta, a Bill of Rights, for users of telecommunications services. The original text of the annex tabled by the United States listed in detail what comprised the critical components of access to and use of public telecommunications transport services:

-- the ability to resell or share telecommunications services to provide a permitted service;

-- the freedom to purchase or lease and attach customer premises equipment, restricted

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only by a "no-technical harm-to-the-network" standard;

-- the ability to interconnect leased circuits with a customer's, or another's, leased circuits, on a mutually negotiated basis;

-- the performance of switching, signaling, and processing functions in connection with such interconnection;

-- the interconnection of leased circuits with the public switched network on reasonable and non-discriminatory terms;

-- the ability of service suppliers and users to choose from among a menu of services, which will be priced at cost-based rates, and, in the case of leased lines, made available also on a flat-rate basis; and

-- the ability to move, store and process information within and across national borders.

This list of "rights" is formidable. It was too tough for many countries to swallow. They did not want to afford as much "access" as some in the United States had wanted, and firmly adhered to the view that regulators need the flexibility to adjust the regulatory environment in light of particular needs and economic circumstances.

Consequently, after much wrangling, the annex that has been negotiated represents a very substantial retreat from the original U.S. position. Although the fundamental structure of the document is not far-removed from what was tabled by the United States, several of the rights mentioned above have been omitted entirely. Others, of course, remain.

The real transformation is that the annex expressly sanctions imposing some conditions on access to and use of public telecommunications transport networks and services. Although the extent to which such conditions can be imposed is significantly limited by the text, some observers are doubtful that those textual restrictions actually will curtail regulatory fervor.

At bottom, therefore, some users, including would-be providers of value-added services, and carriers, are disappointed in what has been produced. A particular sore point, I should note, is that the annex, although ostensibly oriented toward access to and use of public telecommunications services, also would govern, in some respects, arrangements entirely between two suppliers of value-added services. It is somewhat of a stretch, of course, to say that regulating such arrangements has much to do with the terms of access to or use of public telecommunications services.

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The document is, as mentioned above, now roughly balanced between what users need and want and what regulators require. For some, however, it does not go far beyond the status quo. Some think that it simply codifies -- or freezes -- the status quo. Many, frankly, are of the view, that the annex may well become an irrelevancy for most markets, as the tide of liberalization and competition sweeps past it.

On reflection, the annex is a useful benchmark of the minimum conditions for opening up a country's telecommunications sector for service suppliers. The telecommunications world has, in many respects, moved beyond it, or soon will do so. As noted below, however, that does not mean that the negotiations over the annex, or the annex itself, have not been worth the effort and will not have utility for the future.

D. Overall Assessment of the Uruguay Round, and its Implications for the Asia-Pacific Region

After five years of negotiations, it may almost be taken as facetious that it is still "too early" to assess the impact of the Uruguay Round on the telecommunications services sector. Nonetheless, with the outcome of the Round still uncertain, much work to do on negotiating the scheduled commitments in the request/offer process, and with the final text of the annex still not in place, it is difficult to render definitive views. Of course, by far the most critical factor for coming to some conclusions about the negotiations is how countries will, over the next few years, interpret the texts and fulfill their commitments.

With these caveats, however, I believe that

it was better to have the Uruguay Round than not and that the effort has been worth it. The dialogue between and among countries on the importance of telecommunications services has been unparalleled and invaluable. Other than the ITU, there had not previously been the opportunity for sharing information and exploring points of commonality and differences, on a multilateral basis. The bilateral negotiations among countries, or that have taken place on a regional basis, are no substitute for meaningful interaction among the broadest range of nations of significantly different levels of economic development.

In this regard, the negotiations have been an important forum for a dialogue between developed and developing countries on the impact of telecommunications services on national economies; telecommunications can be an engine for growth and efficiency, and ought not to be seen as a threat to a

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country's economic sovereignty.

Newly industrializing countries also played an indispensable and constructive role throughout the negotiations. Here, I have in mind, at least from this region, the documentation provided by both Singapore and Korea and their role in the discussions.

The GATS process also has contributed to a better understanding of the regulatory regimes in countries and to the identification of real barriers to trade in telecommunications services. For service providers and other users -- for carriers, providers of value-added services, and suppliers of the whole range of services that are critically dependent on telecommunications -- there is inestimable value in such transparency.

For the Asia-Pacific region, the dimensions of any long-term benefits from the Uruguay Round are uncertain. Having had the dialogue, of course, brings benefits to service suppliers throughout the region. The process has also been aspirational: countries on the path toward liberalization have a much better appreciation for what might be expected of them. They have more of an incentive to afford market access to service suppliers knowing that to do so will give them some access to other markets. The annex, for example, establishes the principles of access to and use of public telecommunications services, and countries can move to implement those principles in their own regimes.

For the most developed countries, and those furthest along the path toward competition and liberalization, the Uruguay Round process will not mean much in terms of their domestic agenda. For others, it has helped to deflect more focused bilateral pressures. For yet others, it will contribute to a sense that some liberalization of the telecommunications sector makes sense.

For all countries in the region, it is certain that the Uruguay Round, along with the free trade arrangements, the bilateral consultations and the IVANS arrangements, constitute a continuing challenge for all players in the telecommunications sector. It is not technology alone that challenges us. Nor is it economic pressures from customers. Rather, the challenge for many of us as we look toward regional integration in the telecommunications sector is how to create and use the legal and trade regimes that are the new framework for international telecommunications services.

THE PACSTAR OPTION - PAPUA NEW GUINEA'S INVITATION

PRESENTATION BY RON ELIAS
MANAGING DIRECTOR, POST AND TELECOMMUNICATION CORPORATION
PAPUA NEW GUINEA

at the

REGIONAL PACIFIC SYSTEMS SESSION 3.24

of the

PACIFIC TELECOMMUNICATIONS COUNCIL MEETING
15 JANUARY, 1992

IT GIVES ME GREAT PLEASURE TO BE ABLE TO ADDRESS THIS PACIFIC TELECOMMUNICATIONS COUNCIL MEETING AND PROVIDE YOU WITH INFORMATION ON THE PAPUA NEW GUINEA (PNG) INITIATIVE TO LAUNCH THE PACSTAR ASIA-PACIFIC REGIONAL COMMUNICATIONS SATELLITE SYSTEM.

I FEEL PROUD THAT I CAN EXTEND TO YOU, MY FRIENDS OF THE ASIA-PACIFIC REGION, AN INVITATION TO JOIN WITH PAPUA NEW GUINEA AS WE REACH THE CLOSING STAGES OF THE PACSTAR-1 SATELLITE PROJECT. YOUR PARTICIPATION IN THE PROJECT AT THIS TIME PROVIDES YOU WITH IMMEDIATE ACCESS TO PROJECT ASSETS, WHICH ARE WELL DEVELOPED AND AT NO COST TO THE NEW PARTICIPANT. I AM OFFERING TO ASSIST YOU WITH THE REQUIREMENT ASSESSMENT OF THE PACSTAR SPACE SEGMENT AT NO UP-FRONT COSTS AND WITHOUT CREATING ANY OBLIGATION FOR FUTURE USE OF PACSTAR.

THE DESIGN WORK AND MARKETING IS NEARING COMPLETION. THE RESERVATION COST OF LAUNCHING PACSTAR-1 ON THE SPECIAL LAUNCH VEHICLE HAS ALREADY BEEN PAID. MY GOVERNMENT HAS TARGETED THE IMPLEMENTATION OF THE PACSTAR SYSTEM FOR THE END OF 1994. WORLD BANK HAS ASSESSED THE PROJECT AND IS NOW PROVIDING FUNDING FOR THE 'PRE-INVESTMENT' STUDY, AN IMPORTANT ELEMENT OF THE PROJECT FINANCING.

WHY SHOULD MY COUNTRY BE SO INTERESTED IN THIS PROJECT?

TELECOMMUNICATION NEEDS IN PAPUA NEW GUINEA HAVE INCREASED IN RECENT YEARS WITH THE DISCOVERY OF EXTENSIVE MINERAL AND NATURAL RESOURCES IN REMOTE AREAS OF THE COUNTRY. THIS HAS IMPROVED HEALTH AND EDUCATIONAL OPPORTUNITIES AND INCREASED THE NEED FOR HIGHER PRIORITIES TO BE PLACED ON LAW AND ORDER PROBLEMS BY EXPANDING OUR LAW ENFORCEMENT TRAINING PROGRAMMES.

AS HEAD OF THE POST AND TELECOMMUNICATION CORPORATION WHICH HAS RESPONSIBILITY FOR MEETING THESE OBLIGATIONS, I HAVE BEEN PERSONALLY INVOLVED IN OUR EFFORTS TO IDENTIFY COST EFFECTIVE SOLUTIONS FOR EACH OF THESE DIVERSE NATIONAL OBJECTIVES. OUR CONCLUSION IS THAT DISTANCE SENSITIVE COMMUNICATION SATELLITES PROVIDE THE BEST TRANSMISSION MEANS FOR US TO ECONOMICALLY EXPAND OUR NATIONAL TELECOMMUNICATION NETWORKS WHICH REACH THE MOST REMOTE AREAS OF OUR LARGE ISLAND AND INTERCONNECTS WITH MANY OF THE 700 SMALLER ISLANDS THAT COMPRISE THE SOVEREIGN STATE OF PAPUA NEW GUINEA.

WE USE SUBMARINE CABLES AS WELL AS INTELSAT. IN FACT, WE ARE A MEMBER COUNTRY OF INTELSAT AND WE HAVE SERVED ON THE INTELSAT BOARD OF GOVERNORS. WE INTEND TO CONTINUE TO USE INTELSAT FOR SELECTED TYPES OF SATELLITE SERVICES. WE ARE ALSO USING PALAPA TO SATISFY SOME OF OUR DOMESTIC NEEDS. OUR RECENT ANALYSIS OF EXISTING COMMUNICATION SATELLITE SYSTEMS DEMONSTRATES CLEARLY THAT NONE OF THESE SYSTEMS CAN MEET ALL OUR TELECOMMUNICATION NEEDS IN A COST EFFICIENT MANNER. NEITHER CAN ALL OUR NEEDS BE MET BY USING TRADITIONAL TERRESTRIAL METHODS. THE MESSAGE IS LOUD AND CLEAR --- WE NEED PACSTAR TO CATER FOR OUR INCREASING TELECOMMUNICATION REQUIREMENTS.

FOR THESE REASONS, PTC, HAVING THE SUPPORT OF GOVERNMENT AND THE MINISTRIES OF FOREIGN AFFAIRS AND COMMUNICATIONS AND FINANCE INITIATED THE PACSTAR PROJECT SEVERAL YEARS AGO. SINCE THEN WE HAVE BEEN WORKING WITH CARRIERS LIKE TRT AND PACIFIC TELECOM AND PRIVATE ENTREPRENEURS TO IMPLEMENT THE PACSTAR SYSTEM AS A COMMERCIAL AND PRIVATE SECTOR INITIATIVE. THIS APPROACH HAS BEEN USEFUL AS WE HAVE LEARNED DIFFICULT LESSONS - LESSONS THAT HAVE DELAYED OUR PROJECT AND, I SUGGEST THAT OTHERS ON THIS PANEL ARE JUST BEGINNING TO BE AWARE OF.

THE RESULT OF OUR EXPERIENCE TO THIS TIME IS THAT, ALTHOUGH WE ARE STILL CONTINUING WITH OUR OBJECTIVE OF PACSTAR AS A COMMERCIAL PRIVATE SECTOR PROGRAMME, WE ARE WILLING TO STOP AT THIS POINT AND RISK PROCEEDING WITH THE PROJECT ON OUR OWN. SO AS TO ENFORCE THE DEGREE OF RESPONSIBILITY THE PACSTAR PROGRAMME IS HELD BY MY GOVERNMENT, MY CORPORATION HAS RECENTLY INCREASED ITS OWNERSHIP IN THE PROJECT TO A CONTROLLING LEVEL. PAPUA NEW GUINEA IS NOW TAKING THE LEAD IN DEVELOPING THE PACSTAR SYSTEM.

OUR DEVELOPMENTAL PLANS FOR USE OF THE PACSTAR SYSTEM TO THE END OF THE PRESENT DECADE SHOWS MY COUNTRY REQUIREMENTS ARE FOR TWO OR THREE PACSTAR TRANSPONDERS.

FROM THE COMMENCEMENT OF THE PROJECT WE HAVE CONSIDERED THE SATELLITE COMMUNICATION NEEDS OF OTHER ISLAND NATIONS; REGIONAL AND DOMESTIC BROADCASTERS; AND WORKING WITH OUR COUNTERPARTS WE HAVE CONSIDERED THE SMALL EARTH STATION NEEDS OF MULTINATIONAL USERS IN THE MORE DEVELOPED COUNTRIES OF KOREA, HONG KONG, SINGAPORE AND MALAYSIA.

A STRONG MARKETING EFFORT HAS BEEN LAUNCHED TO INFORM OTHER DEVELOPING COUNTRIES AND RECENTLY INDUSTRIALISED NATIONS, WITH LARGER TRAFFIC POTENTIALS BUT INSUFFICIENT TO JUSTIFY A DEDICATED SATELLITE SYSTEM, TO CONSIDER USING THE PACSTAR SYSTEM.

WE HAVE SPECIALLY STRUCTURED THE PACSTAR SYSTEM TO ENCOURAGE YOUR PARTICIPATION IN THE PROJECT AND SUBSEQUENTLY YOUR USE OF THE SYSTEM. LET ME EXPLAIN THE SYSTEM TO YOU.

FIRST, THE PACSTAR SYSTEM CONSISTS OF TWO HIGH POWERED COMMUNICATION SATELLITES WHICH WILL WORK INTO LOW COST, EASILY INSTALLED AND MAINTAINED EARTH STATIONS. THESE EARTH STATION NETWORKS ARE THE OPTIMAL WAY TO COST EFFECTIVELY DEVELOP TELECOMMUNICATIONS INFRA-STRUCTURES. THIS ALSO APPLIES TO REMOVE AREAS WITH LOW DENSITY TELECOMMUNICATION NEEDS SUCH AS IS EVIDENT IN MOST OF THE PACIFIC ISLAND NATIONS.

THESE TECHNICAL AND ECONOMIC ADVANTAGES OF THE PACSTAR SPACE SEGMENT ALSO ALLOW ATTRACTIVE NEW OPPORTUNITIES FOR PROSPECTIVE USERS IN THE MORE DEVELOPED COUNTRIES WITHIN OUR REGION BY MAKING NEW GROWTH SERVICE APPLICATIONS AFFORDABLE FOR THE FIRST TIME. THESE NEW GROWTH SERVICES BENEFIT END USERS BY IMPROVING THE QUALITY AND AFFORDABILITY OF NON-TRADITIONAL TELECOMMUNICATION SERVICES.

SECOND, TO ENSURE THESE SPECIALISED COMMUNICATION REQUIREMENTS, TWO ORBITAL POSITIONS WERE SELECTED AND, AFTER INTENSIVE TECHNICAL ANALYSIS A COVERAGE WAS OBTAINED OF THE EAST AND WEST RIM OF THE PACIFIC BASIN, THE ASEAN NATIONS AND THE SOUTH PACIFIC INCLUDING NEW ZEALAND AND AUSTRALIA. THAT WAS IN 1985.

NOW IN 1992, IN THE PACIFIC REGION, THERE IS A SEVERE CONGESTION OF THE ORBITAL ARC SO THAT IT IS NO LONGER POSSIBLE FOR COUNTRIES TO SECURE SUITABLE ORBITAL SPECTRUM WITHOUT INCURRING SUBSTANTIAL EXPENSE, IF AT ALL. PACSTAR OFFERS THE PACIFIC ISLAND NATIONS A POSITIVE SOLUTION TO THIS PROBLEM BECAUSE, UNLIKE OTHER PACIFIC REGIONAL SATELLITE INITIATIVE, THESE TWO OPTIMAL ORBITAL POSITIONS LOCATED AT 167.45 EAST LONGITUDE AND 175 WEST LONGITUDE, WERE OBTAINED LONG BEFORE THE CURRENT SCARCITY OF PACIFIC ORBITAL POSITIONS BECAME EVIDENT.

FURTHER LET ME SAY, THE INTERNATIONAL CO-ORDINATION PROCESS WHICH GENERALLY TAKES UP TO THREE TO FOUR YEARS, HAS NEARLY BEEN COMPLETED. THIS MEANS THAT WHEN NEW SATELLITES OR THE RE-POSITIONING OF EXISTING SATELLITES BECOMES NECESSARY, THE COUNTRY CONCERNED ***MUST*** ENSURE THAT THESE DO NOT INTERFERE IN ANY WAY WITH THE TWO PACSTAR SATELLITES. THIS IS A TREMENDOUS ECONOMIC, TECHNOLOGICAL AND OPERATIONAL ADVANTAGE TO PAPUA NEW GUINEA AND TO ANY OTHER NATION THAT JOINS THE PACSTAR PROJECT.

THIRD, IN ADDITION TO THE TECHNICAL ADVANTAGES OF THE HIGH POWER OF THE PACSTAR TRANSPONDERS AND THE OPPORTUNITY TO USE THE PERFECTED ORBIT SPECTRUM, THE REVENUE POTENTIAL FOR TELECOMMUNICATION AUTHORITIES AND BROADCASTERS TAKING PART IN THE PACSTAR PROJECT IS EVIDENT. IN ADDITION, THE LOW COST EARTH STATIONS WHICH ARE USABLE WITH PACSTAR, AND NOT WITH ANY OTHER SATELLITE SYSTEM, GIVE TELECOMMUNICATION AUTHORITIES AND BROADCASTERS NEW BUSINESS OPPORTUNITIES IN EDUCATIONAL AND COMMERCIAL BROADCASTING. PACSTAR CREATES SIGNIFICANT NEW REVENUE OPPORTUNITIES FOR THOSE WHO PROCURE A PACSTAR SPACE AND CONTROL ACCESS TO THE EARTH STATION FACILITIES.

FINALLY, AND POSSIBLY THE MOST ATTRACTIVE FEATURE IS THAT PACSTAR IS NOW IN THE FINAL STAGE OF DEVELOPMENT. WE HAVE COMPLETED THE PACSTAR-1 SATELLITE PERFORMANCE SPECIFICATION AND HAVE SUBMITTED IT TO SEVERAL MANUFACTURERS. WE USE APRIL FIRST OF THIS YEAR AS THE TARGET DATE FOR PROCUREMENT UNDER A PRIORITY SCHEDULE SO THAT WE CAN ACHIEVE OUR LAUNCH DATE OF 1994.

THE BOTTOM LINE IS THAT PACSTAR-1 WILL BE IN ORBIT BY THE END OF 1994 AND COMMERCIALLY OPERATIONAL BY EARLY 1995. THE TECHNICAL WORK OF CUSTOMISING THE PACSTAR TRANSPONDERS AND THE CONFIGURATION OF THE PACSTAR-1 SATELLITE MUST BE ENTIRELY COMPLETED WITHIN THE NEXT FEW MONTHS.

I EXTEND TO YOU AN INVITATION TO JOIN US IN IMPLEMENTING THE PACSTAR PROJECT NOW AND CAPTURING AND SHARING THE BENEFITS WHICH WILL BE ENJOYED BY PAPUA NEW GUINEA, THAT IS, A CUSTOMISED TRANSPONDER AT COMPETITIVE PRICES, THE USE OF A WELL DEVELOPED SATELLITE AND LAUNCH VEHICLE, ACCESS TO PRIORITY ORBIT SPECTRUM RESOURCES, TECHNOLOGY TRANSFER BENEFITS AND LOTS MORE.

I LOOK FORWARD TO DISCUSSING THIS PROJECT WITH YOU DURING THE REMAINDER OF THE CONFERENCE --- THANK YOU.

THE IMPORTANCE OF OPEN MARKETS IN INTERNATIONAL TELECOMMUNICATIONS TRADE

REMARKS BY

ALLEN R. FRISCHKORN, JR.

PRESIDENT

TELECOMMUNICATIONS INDUSTRY ASSOCIATION

AT

THE 14th

PACIFIC TELECOMMUNICATIONS CONFERENCE

JANUARY 15, 1992

HONOLULU, HAWAII

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I very much appreciate the opportunity to appear here today to talk about the importance of open markets to worldwide trade in telecommunications. Obtaining greater access in foreign telecommunications equipment markets is one of the priorities of the Telecommunications Industry Association.

The Telecommunications Industry Association is a full service national trade association representing around 500 manufacturers and suppliers of telecommunications equipment. TIA member companies manufacture or supply virtually every product used in today's telecommunications network. Our members are competing for business in the world market for telecommunications products. Accordingly, they are very concerned about fair competition.

TIA and its member companies are committed to working for open telecommunications markets around the world. Telecommunications has been recognized as a necessary prerequisite to economic growth and, as such, is a critical ingredient for developing countries seeking to "jump start" their economies as well as for developed countries which are seeking to enhance their competitiveness in an increasingly global

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marketplace. To encourage telecommunications manufacturers around the world to produce the most sophisticated products possible at the least cost requires free and fair competition in telecommunications equipment in every market. Enhancing market access opportunities abroad to match the openness of the U.S. market is therefore a fundamental goal of TIA.

There can be little doubt that the U.S. market is open to free and fair competition in telecommunications equipment. FCC deregulatory actions over the past twenty years coupled with the divestiture of the Bell Operating Companies by AT&T have created a huge open market for telecommunications products. Foreign telecommunications manufacturers are very active in the U.S. market. All of the major foreign telecommunications producers now manufacture in the U.S. and are doing steadily increasing business with the Bell Operating Companies and other telephone companies.

While the U.S. market is open, U.S. telecommunications equipment manufacturers face less than an open market abroad. Foreign

government buy-national policies, cultural preferences and other non-tariff barriers have effectively precluded U.S. companies from achieving comparable competitive opportunities in many countries. Meanwhile foreign company penetration in the U.S. market has been steadily increasing.

I'd like to take a moment to explain why market access is so important. Because of the high cost of developing state of the art telecommunications products, economies of scale are crucial for success in the telecommunications equipment business. It doesn't take a PhD in economics to figure out that if our competitors have a monopoly in their home market coupled with free access to our market, and we only have access to our market, all things being equal our competitors will win out in the long run. U.S. companies need access to our major competitors' markets to subject such competitors to the rigors of price competition. Such competition will force the prices of our competitor's products towards their costs, thereby eliminating the monopoly profits which can be used to undercut U.S. suppliers in third countries or in the U.S. market. In other words, only free and open competition will assure

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U.S. manufacturers a level playing field in the world telecommunications marketplace.

While these goals seem self evident, free and fair competition in telecommunications equipment in many markets is illusive. Many countries do not revere the free enterprise marketplace as we in the United States do. The countries of particular concern in terms of market access are those with large internal markets that export substantial amounts of telecommunications equipment to the United States. These countries include Japan, Canada, EC countries and Korea.

Historically, U.S. producers have been locked out of the Japanese market. However, the U.S. and Japan have entered into two major agreements over the past ten years designed to open up that market.

The first agreement – the so-called NTT agreement – was designed to open up the then government owned telephone monopoly to U.S. suppliers. Under the agreement, U.S. companies have sold over $1.5 billion of equipment to NTT since 1981. Sales over the past 2 years have

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been increasing by a larger percentage than previous years. I believe that this is due in large part to the efforts of top NTT management. Despite this progress, however, the U.S. share of the NTT market continues to hover around only 4%. We will continue to work with NTT in the hope that U.S. company participation in the NTT market -- still by far the largest telecommunications equipment market in Japan -- continues to increase.

In 1985, the U.S. and Japan entered into "market oriented, sector specific" or "MOSS" agreements. These agreements were designed to give U.S. manufacturers greater access to the customer premises equipment and radio equipment markets in Japan. While some progress has been made under the MOSS agreements, a number of problems have arisen including a major problem involving Motorola's access to lucrative cellular frequencies. This problem was resolved satisfactorily in 1989. More recently, the U.S. and Japan reached agreement on telecommunications issues involving satellite procurement, digital terminal equipment and value added networks. Discussions are now in progress concerning increased access to the Japanese government

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procurement market. While all problems haven't been resolved progress is being made.

Finally, deregulation in Japan has spawned a whole new group of carriers called the New Common Carriers or "NCC's". These competitors to NTT have created additional business opportunities for U.S. companies. U.S. companies are taking advantage of these opportunities and sales to this new group are growing steadily. Since Japan still accounts for the great bulk of the U.S. trade deficit in telecommunications – $1.8 billion during 1990 – they will remain a major focus of our market access efforts.

In Europe, many markets have been closed to U.S. manufacturers unless the U.S. companies set up in-country manufacturing operations. Historically, most European countries have buy-national policies designed to protect jobs in the domestic economy. That has been changing more recently in a number of countries.

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The United Kingdom, for example, has one of the more open markets in Europe for telecommunications equipment. In the last several years both the French and Germans have begun to liberalize their telecommunications markets. We have worked with the French and Germans and have encouraged them on these actions. It is still too early to tell whether these liberalization measures will take hold and whether real sales opportunities will be created for U.S. manufacturers.

We have also been working closely with the European Community (EC) in Brussels on its 1992 single market initiative. During the course of its 1992 activities, the EC has issued a number of directives on telecommunications, including directives on procurement, standards, and type approval of interconnect equipment.

We have some concerns about the EC procurement directive since it includes a buy-European provision. However, the elimination of intra-EC barriers will enable U.S. companies manufacturing products in Europe, to access the entire EC telecommunications equipment market. We will be watching as the EC countries implement the procurement directive.

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In the meantime, there is an effort underway in the GATT round to bring PTT's, including the European PTT's, under the Government Procurement Code. If that happens, U.S. companies will receive national treatment for purposes of telecommunications procurement.

Our association has begun to work with the European telecommunications Standards Institute ("ETSI") to coordinate our standards activities with those of that organization. We are hopeful that the ETSI process will be open and transparent and that the standards setting process will no longer be used as a barrier to market access.

The EC type approval directive is now being implemented by EC member countries. It should simplify and harmonize the various type approval requirements in EC countries thus allowing equipment approved in one EC country to be sold in other EC countries. We will be watching to see how individual countries implement the directive.

The market access problem in Canada stems from the fact that Bell Canada is vertically integrated and buys virtually all of its equipment

from its affiliated supplier under a "preferred supplier" arrangement. Since Bell Canada is over 60% of the Canadian telecommunications equipment market, U.S. manufacturers are effectively shut out of the biggest part of that market. Efforts were made by the U.S. government to end the Bell Canada preferred supplier arrangement during the U.S./Canada free trade negotiations. Those efforts were unsuccessful but the issue remains an irritant in the U.S./Canada trade relations.

The U.S./Canada free trade agreement makes some improvements for telecommunications trade between the two countries. Prior to the agreement, tariffs on any telecommunications equipment exported from the U.S. to Canada were about twice as high as those on equipment shipped to the U.S. from Canada. The agreement provides for accelerated elimination of tariffs on some equipment with the elimination of all tariffs over ten years. The tariff changes will result in additional opportunities for U.S. companies in Canada. However, unless the Bell Canada preferred supplier problem is resolved the biggest part of the Canadian market will still remain off limits for U.S. telecommunications equipment manufacturers.

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With respect to Korea, U.S. companies have been concerned for many years with the Korean government's buy-national policies with respect to all of its telecommunications needs including the procurement of then KTA. Moreover, there was a suspicion that the standards and the equipment approval process for interconnect equipment was being used to discourage the import of telecommunications equipment. This was of particular concern to U.S. manufacturers since Korean telecommunications exports to the States have grown dramatically over the past several years to a high of nearly half a billion dollars in 1990.

Because of all of these market access concerns of the U.S. industry, TIA and its member companies lobbied the U.S. Congress for tough legislation to open up foreign telecommunications equipment markets. These lobbying activities culminated with the passage of the Omnibus Trade and Competitiveness Act of 1988. That legislation contained telecommunications market access provisions which were designed to address foreign barriers to U.S. telecommunications equipment manufacturers.

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Specifically, the legislation authorized the President to identify the countries which did not give U.S. telecommunications equipment suppliers reciprocal market opportunities. Once those countries were identified, the President was authorized to commence negotiations to remove trade barriers and to increase the market access of U.S. manufacturers. If such negotiations are unsuccessful, the President was further authorized to take retaliatory action against products entering the U.S. from the offending countries.

Subsequent to the passage of the legislation, the European Community and Korea were identified as countries which did not give reciprocal market access opportunities to U.S. companies. Negotiations were begun with those countries in 1989 and are still in progress. In addition, other provisions in the legislation provided for the annual review of agreements previously negotiated with Japan and other countries to determine whether they are being complied with.

Although all market access problems with these countries have not been resolved, substantial progress has been made.

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In Europe, the EC'92 initiative will eliminate many trade barriers among European countries in the telecommunications sector. American companies which operate in Europe will be able to take advantage of intra-EC telecommunications liberalization. However, as mentioned earlier, exports from the U.S. will still be subject to a buy-European preference. This issue is the focus of the continuing negotiations with the EC to have American exports treated the same as exports among E.C. countries. Since certain of the U.S.-E.C. telecommunications issues are similar to issues being considered under the GATT Government Procurement Code, the procurement part of the U.S.-E.C. telecommunications negotiations have been rolled into the GATT Round. We are hopeful that those negotiations will ultimately result in a resolution of the telecommunications trade issues. However, if they are not successful, the U.S. must consider its options, including retaliation, to rectify the competitive imbalance.

With respect to Korea, negotiations on telecommunications manufacturing issues have gone very well. The Koreans have announced plans to open the procurement of Korean Telecom to U.S.

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companies over a two year period beginning in 1992. Under the procurement changes, U.S. companies will not be discriminated against when bidding for business with Korean Telecom.

Just this month, we were visited by a Korean delegation which explained a number of changes taking place in telecommunications in Korea. Based on that presentation, it appears that many of the problems in the areas of procurement, standards and type approvals are being satisfactorily addressed. We had hoped that Korea would put its telecommunications procurement under the government procurement code of the GATT round. However, at the present time, it is unclear how the GATT procurement discussions will proceed. Nevertheless, the commitment of the Korean government to open up telecommunications procurement will be implemented on a bilateral basis over the next two years. TIA will be working closely with Korea Telecom and the Korean government as this process moves forward.

In my view, the GATT negotiations offer an opportunity for us to obtain an agreement which will open up telecommunications authorities

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worldwide to competitive procurement for the first time. Under the Government Procurement Code, countries participating agree to treat companies from other signatory countries the same as their own companies for purposes of government procurement. Since telecommunications authorities are government owned in most countries, extension of the Code to PTT's would open up their procurement to U.S. manufacturers. We hope that the issues delaying progress in the GATT are resolved and that negotiations move ahead to resolve the outstanding difficult telecommunications issues under the Government Procurement Code. However, if the GATT government procurement discussions break down, the U.S. will pursue its market access goals on a bilateral basis.

The creation of an open system of telecommunications procurement worldwide has advantages for everyone. Under such a system, decisions on which equipment to purchase will be made on the basis of price, quality and service rather than on the nationality of the seller. This will assure that the purchaser gets the best product at the best price. Consumers of telecommunications service will not have to pay for

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inefficiencies in the manufacturing process. Manufacturers will have to compete on the basis of price, quality and service. The efficient will prosper and the others will fall by the wayside. Finally, eliminating protection barriers will remove a major trade irritant among the nations of the world. Resources now devoted to resolving trade disputes can be shifted to more productive uses such as promoting the development of telecommunications in developing countries where such development is essential for economic growth.

In summary, market barriers still exist in many countries. Since the U.S. market is open, the U.S. industry must eliminate foreign trade barriers to remain competitive. The U.S. industry and the U.S. government are working hand in hand, both bilaterally and multilaterally, to bring about a fully competitive world market for telecommunications equipment. Such a market has many advantages for consumers, telecommunications service providers and manufacturers. A major source of trade friction could be eliminated and government and private resources now devoted to market access battles, could be put to more productive uses.

Thank you for your attention. I'd be happy to answer any questions you may have.

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COMPETITION AMONG SATELLITE SYSTEMS AND THE CREATION OF NEW COMMUNICATIONS MARKETS

by Douglas Goldschmidt & Philip Rubin
Alpha Lyracom Space Communications

The Pacific Rim nations are about to experience a significant increase in the availability of satellite facilities. While the area is currently served only by Intelsat, AsiaSat, and to a limited extent, by domestic satellite systems in Japan, Indonesia, and China, there will be an increase in service availability over the next three years due both to the expansion of existing systems, particularly Palapa and possibly Aussat, and the introduction of new specifically competitive services by Alpha Lyracom, Columbia Communications, and possibly one or two other satellite systems. The increased capacity and the new competition will have dramatic effects on the type, range and price of communications services in the Pacific Rim.

Alpha Lyracom and Latin America

To a large degree, the availability of satellite services in the Pacific Rim is similar to the historical situation in Latin America. Prior to the PAS-1 launch in 1988, Latin America had few satellite services available to it. Brazil and Mexico have had their own satellite systems for some years, but these were purely for domestic communications and offered few services to neighboring countries. Other countries utilized leased Intelsat capacity primarily for domestic telephone services. Intelsat's services were optimized for international connectivity among gateway stations and were poorly designed for any applications requiring multiple uplinks and downlinks, such as domestic video distribution or business communications. Furthermore, the Intelsat signatories charged exorbitant amounts to potential national users. The high cost of using Intelsat was reflected by the low level of demand for Latin American satellite services -- there was no projected full time video traffic for the region in the Intelsat GTM prior to 1988, and extremely modest amounts of IBS.

Alpha Lyracom's entry into the Latin American market had an enormous affect on market demand and supply. Aside from the supply its satellite introduced to the market, Intelsat, as a competitive response to PAS-1, modified its VB satellites to offer higher powered domestic services. Hence, Latin America, which previously had no high powered services, by 1988 had two satellites offering the type of performance usually associated with domestic satellite systems.

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More importantly, as a new competitor, Alpha Lyracom actively and aggressively marketed its transponders for domestic services, and for regional data and video services. It was the *combination* of new supply with direct marketing to consumers, bypassing the conservative national telecommunications administrations, which led to dramatic changes. For, once users found that they could get services superior to those offered by their local telephone companies using Intelsat capacity, and more importantly, at lower overall costs, the political pressure for liberalization became uncontrollable. And, as the pressure to liberalize grew, the PTT's themselves became more interested in providing services appropriate to the users.

The results have been impressive. In 1988 there were *no* regional video networks. Today there are seven full time regional networks, and a number of part time news and sports networks on PAS-1. In 1988 there were no private domestic satellite based networks. Today there are networks in Chile, Argentina, Venezuela, and Peru which all use PAS-1 spot beams. And, far more networks would exist if Alpha Lyracom had more capacity. Similarly, we are seeing the rapid development of private data networks, with faster developments possible if local regulations were more liberal than at present.

The key to this discussion is not simply Alpha Lyracom's success in introducing its satellite service, but in the effect that competition had on the overall market. As any economist would predict, competition has markedly lowered prices, increased diversity, and increased the overall market size. Not only is Alpha Lyracom's full time dedicated video capacity completely sold out in Latin America, but so is Intelsat's dedicated domestic capacity, and Intelsat is facing a capacity shortage. Future entry has been expanded not only by Alpha Lyracom's, Intelsat's, and Brazilsat's new series of satellites, projected to be launched in 1994/95, but by capacity on the new Mexican Solidaridad satellites and Spain's Hispasat.

Developments in the Pacific

There are a number of satellite systems under development in the Pacific. For obvious reasons (our competitors can speak for themselves), I will focus on Alpha Lyracom's two Pacific oriented satellites: the ORBX-2 and ORBX-4.[1]

Alpha Lyracom recently signed an agreement with Hughes Communications for the construction of three new satellites using the Hughes HS-601 3-axis stabilized satellite bus.

ORBX-2 will be stationed at 192° WL, while ORBX-4 will be stationed at 72° WL.[2] ORBX-2 is designed to offer Trans Pacific coverage, going as far west as Thailand and as far east as California. It will also offer transponders for regional and domestic communications services, in C band and Ku band, throughout the Pacific Rim. Importantly, ORBX-2 will offer high powered footprints of the Pacific Islands. ORBX-2's footprint is shown in Figure 1.

ORBX-4 is designed primarily for service to central Asia, Africa, and eastern Europe. However, it will offer connectivity between the United Kingdom in the West and Japan in the East. The satellite will thus, link the Pacific Rim nations to Europe and Central Asia, the only satellite to offer such an extensive range of coverage. ORBX-4's draft footprint is shown in Figure 2.

The three new ORBX satellites will be C/Ku Band hybrids with thirty-two operating transponders, sixteen in each band. The C band transponders will utilize 30 watt amplifiers, while the Ku-band transponders will utilize 63 watt TWTA's. The ORBX satellites will be the first FSS satellites to utilize a new technical approach to generating footprints that follow the desired coverage area boundaries with a unique precision. This new technical approach has the potential to reduce satellite weight and complexity, improve spacecraft EIRP and G/T, and improve reliability. The design will replace the multiple feedhorn design of today's spacecraft and result in reduced satellite costs and lower transmission losses in addition to the benefits desribed earlier. Each ORBX satellite will produce up to fourteen separate beams using this technology, which will be the conerstone of the satellite's technical capability.

ORBX will also have the ability to switch certain transponders between beams. This will allow the rearrangement of satellite capacity as the market dictates. With cross-strapping and transponder switchability, no area is uncovered, and certain areas will have the flexibility to increase traffic capacity in areas requiring such growth.

The ORBX spacecraft will have from upwards of fourteen years to as many as twenty-five years of life, depending on the launch vehicle selected. Negotiations are currently underway with a number of launch vendors, and a launch reservation has already been make with the Chinese Long March.[3]

The ORBX communications payload has been expressly designed to facilitate the transmission of digital carriers. While analog traffic would not be excluded, the satellite will operate most efficiently when digital traffic

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occupies any transponder. As such, each transponder includes a linearizer within its general design allowing multi-carrier operation at the highest operating point possible. While nominal transponder bandwidth has been set at 54 Mhz, each spacecraft will have two transponders with wider bandwidths available to accommodate higher rate digital carriers.

The ORBX Satellites and Service Offerings to the Pacific Rim

To date, the Pacific Rim's services have either been through the "conventional" Intelsat services, offered on aged capacity, or on domestic satellites with limited coverage. The launch of the Intelsat VII series will not have a significant effect on regional communications as Intelsat's orientation remains international, rather than to the particular needs of a region or nations. And, more importantly, Intelsat's relationship with its signatories significantly hinders its ability to respond in a competitive way to user requirements.

AsiaSat has offered an important new service to the region, but its capacity is both limited in quantity and scope -- it only offers C-band service. Columbia will only be able to offer medium powered C-band service for Trans Pacific service. And, the other proposed Pacific satellite systems have failed to attract the necessary investments to date to initiate construction.

Alpha Lyracom is irrevocably committed to the ORBX system -- the construction contract has been signed and the financing is in place. Construction on ORBX-2 has already begun. The satellite's launch in 1994 will immediately introduce direct competition with Intelsat for international video and digital services, and with Intelsat and AsiaSat for regional and domestic video and digital services. Competition with national satellite systems will be less direct as we assume that national systems will dominate in their respective territories.

Rather than simply entering the market as another provider of satellite capacity, Alpha Lyracom intends to promote a series of innovative services which are either incipient or not offered at all in the region. In particular, we intend to offer:

- compressed video for entertainment and news distribution. By moving away from analogue transmission we anticipate drops in video networking costs of approximately 60% by 1995. And, by integrating compressed video with dynamic transponder allocation technologies, it will be possible to provide "instant" transmission

services to meet the requirements for special events and news services.

- multipoint integrated digital networks utilizing mesh TDMA and SCPC technologies for domestic and regional telecommunications. Moving away from hub systems and from fixed assigned systems will greatly improve the quality of digital systems and, more importantly, will improve their flexibility while dramatically reducing their cost.

- on-demand bandwidth services to meet the changing requirements of businesses for voice, data, and videoconferencing applications.

We expect that both introducing Alpha Lyracom's capacity and the services will have an enormously stimulating affect on regional communications. The most immediate effect will be on regional and domestic video -- the high powered satellite signal tied with the introduction of digital compression will help jump start regional and domestic video networking for entertainment, news, and business. The competition to provide different types of digital services will similarly stimulate the development of integrated digital systems to augment and, in some cases compete, with the domestic terrestrial networks. If Latin America is any example, the following can be expected:

- video networking costs will drop by about 60% over current costs;

- international digital transmission costs will drop by over 50%;

- digital networking costs will edge downwards, with a probable decrease of 25% within two years of increased competition;

- existing suppliers, notably Intelsat, AsiaSat, and possibly some of the domestic satellite providers, will react strongly to the competition, further reducing satellite transmission prices and end user prices. More importantly, services will be tailored around user requirements rather than around the dictated services now offered by monopoly service providers.

1. There are four satellites in the ORBX series: ORBX-1, formally known as PAS-1, which currently provides service to Latin America and between the U.S. and Europe, ORBX-2, which will cover the Pacific Rim, ORBX-3, which will augment ORBX-1's coverage, and ORBX-4, which will cover the Indian Ocean Region.

2. ORBX-3 will be positioned over the Atlantic Ocean at 39.5° WL for Atlantic Ocean Region services.

3. The Long March may be precluded by U.S. restrictions on exports of high technology equipment to China.

REGULATION OF WIRELESS COMMUNICATIONS - THE NEED FOR REFORM
AN AUSTRALIAN PERSPECTIVE

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14TH PACIFIC TELECOMMUNICATIONS CONFERENCE
SHERATON WAIKIKI HOTEL, HONOLULU, HAWAII
JANUARY 12-15 1992

ABSTRACT

This paper examines the recent flurry of activity in Australia to bring about radical reform of management of the radio frequency spectrum which will affect both telecommunications and broadcasting in significant ways. The general thrust of the reform proposals is to move towards a market based system for allocating frequencies, but this is likely to happen more gradually than was the case in New Zealand.

BACKGROUND

The last few years have seen a rash of inquiries into Australia into management and allocation of the radio frequency spectrum by a Federal Parliamentary Committee (the House of Representatives Standing Committee on Transport Communications and Infrastructure), the Bureau of Transport of Communications Economics and the Department of Transport and Communications.

Such inquiries are a response to revolutionary technological changes which are occurring in the communications industry and the unprecedented pressures being applied to the spectrum as a finite resource. The plethora of inquiries is doubtless also a reflection of the influence of free market ideology on public administration.

Twenty years ago demand for the radio frequency spectrum was much less than it is today, and it principally came from the public sector (eg Defence, Post Master General's, Civil Aviation, Maritime Surveillance/Search and Rescue and other transport uses), and from heavily regulated private sector industries like television and broadcasting, plus two way voice radio users.

Today those all continue to be important uses. But they have been joined by new uses - the ubiquitous portable telephone, new information and entertainment services, including video and audio entertainment and information services such as Sky Channel and various forms of non-broadcast radio, and FM radio (which made its Australian appearance in 1974). In the last ten years in Australia we have seen State Governments moving to build their own communications networks, partly using the radio frequency spectrum.

MOBILE COMMUNICATIONS, WIRELESS LANS AND OTHER NEW USES OF THE RADIO SPECTRUM

On the horizon is an enormous boom in mobile communications both of data and voice. By the end of this century, we are likely to have very extensive personal communications networks: instead of having telephones attached to wall sockets at home and at work, and a mobile phone in the car, many people will have a small handset the size of a dictaphone and just as portable which will interact with the PABX at work, but which will also be used at home or on the move. Similarly we will see the early introduction of systems which enable fixed and mobile computers to communicate with one another both in local areas and over wide areas, but without the costs and inflexibility and lack of mobility which come with a totally wired network. The proponents of these new uses of the radio frequency spectrum are principally in the private sector. The users of them will be in all sectors of our community. Governments will be very heavy users.

These new uses and users have put and will put increasing demands on the radio frequency spectrum. In Australia, the amount of radio spectrum which is available for use at any one time is limited by a number of factors:

- the complex design of radiocommunications equipment and the impracticality of Australia departing from International standards gives Australia little choice in some frequency bands. We generally follow Europe and North America;

- broadcasting is a major user of radio frequency spectrum, especially in the valuable area below 1000MHz. This effectively limits the amount of spectrum available for other radiocommunications users;

- the extent to which the spectrum may be used is limited by the available technology; and

- use of one segment of the radio spectrum may cause interference in another segment.

However the picture is not entirely one of increasing demands on a static resource. Although the radio spectrum is a finite resource, it does not follow that it has a fixed capacity to transmit information. Engineering advances have opened up new parts of the radio frequency spectrum, and many of the new users are accommodated in those parts of the spectrum. Additionally, engineering advances have greatly increased the efficiency of use of the existing spectrum - both through frequency reuse techniques, so that the same part of the spectrum can be reused again and again even within very small geographic areas, and through techniques such as digitalisation which allow a much greater volume of information to be transmitted through the same radio channel as previously. Furthermore, in Australia we have traditionally taken a very conservative approach to allocation of the frequency in order to avoid possible interference between different users. There is possibly scope to be a little less conservative.

The other influence causing a re-examination of the way we allocate frequency is a loss of faith in the ability of Government regulators to allocate scarce resources, and the converse love affair we had during the 1980s with the free market. That love affair lingers though the flame flickers less brightly. The notion that the free market is the best way to allocate scare resources has been a strong influence in the adoption of the auction system of allocating frequency spectrum in New Zealand, and was a heavy influence on the report of the Australian Bureau of Transport and Communications Economics into the Management of the Radio Frequency Spectrum.

WHAT IS THE CURRENT SYSTEM OF MANAGEMENT/REGULATION OF THE RADIO SPECTRUM IN AUSTRALIA?

The management of the radio spectrum is an exclusive Commonwealth responsibility under section 51(v) of the Commonwealth Constitution. The Constitution also empowers the Commonwealth to legislate for external affairs, which provides a basis for the application of international conventions to spectrum management.

NATIONAL MANAGEMENT

The Australian system of management radio spectrum is principally one of licensing by the Government for a specific use over a specified period. The licensing system is regulated through the operation of two Acts:

- The *Radiocommunications Act 1983* administered by the Minister for Transport and Communications using the Department as a national spectrum planning authority;

- The *Broadcasting Act 1942* administered principally by the Australian Broadcasting Tribunal.

The Minister's role under the *Radiocommunications Act* (the *"Radcom Act"*) is to facilitate the use of the radio spectrum through the issue of licences on a first come first served basis. While licences can be cancelled or not renewed, the practice has been that once issued they are seldom terminated.

There have been interesting developments in recent months in the use of Frequency Reservation Certificates (FRCs). Under s.21 of the *Radcom Act*, it is possible to reserve frequency assignments usually for a period of 12 months for future uses and, thus, provide an environment in which investment can be undertaken with the knowledge that a certain frequency is reserved and will not be assigned to someone else. The holder of a FRC has a guarantee that so long as the certificate remains current no other person will be assigned that frequency for any use that would prohibit the use of the reserved frequency. FRCs are not licences and do not authorise transmission on the reserved frequency. In addition, the issue of a FRC gives no guarantee that the person who holds the certificate will ultimately be granted a licence. One drawback with FRCs is that under the Department's administrative arrangements, frequencies covered by an FRC cannot be assigned to new users in the event that demand exceeds the assignment availability in that band. The Department has recently moved to address this problem and new guidelines have been approved which restrict the holding of FRCs in trunked land mobile spectrum where continuing network development is not evident. Current experience is that if you obtain an FRC it only lasts for one year and there is no obligation on the Department to renew the reservation. If after that time, the system is not "operational", the Minister may cancel the certificate. The Minister therefore has a discretion

If we are to auction spectrum, when do we do so? Should we auction it off all at once? Or should we only auction off those parts that seem to be in immediate demand? Is auctioning just an attractive way of raising public revenue while abrogating wider public responsibilities?

Especially given the revolutionary developments which are taking place in communications - for example the ability for one computer to transmit data to another via radiocommunications, the ability to use parts of the spectrum which previously were unusable, and increases in efficiency of spectrum use through new digital techniques, and the like - the analogy with land tends to break down. The uses we can make of land tend to change only slowly over time. The uses we can make of the radio frequency spectrum change very quickly and very dramatically. An auctioning approach would not be sophisticated enough to encourage innovative use of the radio frequency spectrum. Rather it could tend to entrench established players, and could tend to militate against innovation. Enthusiasm for the market needs to be tempered by responsive regulators ensuring that the radio frequency spectrum is used in the public and as well as the private interest.

REFORM OF AUSTRALIAN SPECTRUM MANAGEMENT

There is considerable interest at present in Australia in the need to reform existing arrangements for managing and allocating radio frequency spectrum. In late 1990, the Bureau of Transport and Communications Economics ("BTCE") published a major report on the subject and recommended the introduction of a market-based system to replace the current radiocommunications assignment system. The proposed system would have the following features:

- the creation of Spectrum Access Rights ("SAR's");
- open trading in SAR's (i.e. turning the spectrum into a marketable commodity);
- holders of an SAR would be free to alter the technical parameters, the number of services and uses within the spectrum package, provided they do not exceed the stipulated conditions related to interference;
- auctioning of SAR's, where appropriate;
- in other cases, SAR's would be available over-the-counter at a charge consistent with efficient pricing principles; and
- other charges would be applied to users on a cost recovery basis.

In November 1991, in its report entitled "Economic Aspects of Broadcasting Regulation", the BTCE echoed its earlier report and recommended a number of fundamental changes to the regulation of Australian broadcasting, including:

- the introduction of a system allowing broadcasting spectrum access rights to be bought and sold;
- unrestricted entry to various broadcasting markets, involving the elimination of artificial restrictions on entry, such as commercial viability tests;
- allowing broadcasters greater freedom in choosing the technology or mode of delivery for their services, but obliging them to provide technically adequate signals throughout pre-defined service areas.

Some, but not all these proposals have been subsequently incorporated in the exposure draft of the new Broadcasting Services Bill (see below).

PARLIAMENTARY INQUIRY INTO MANAGEMENT OF THE RADIO FREQUENCY SPECTRUM

The House of Representatives' Standing Committee on Transport, Communications and Infrastructure has recently conducted an Inquiry into Management of the Radio Frequency Spectrum and the need for reform. The Committee received various written submissions, including a major submission from the Department of Transport and Communications. The Committee's October 1991 report is likely to be seen as a blueprint for the future direction of its subject matter in Australia.

The Committee concluded that the current approach in Australia to spectrum management is deficient with respect to:

- Dynamic efficiency: current spectrum management practices lack flexibility and timeliness with regard to changing demand for spectrum use;

to shift potential users out of the radio spectrum if the frequency is not utilised after a period of one year. Under s.86 of the *Radcom Act* such a decision by the Minister is a "reviewable decision" and an application may be made to the Minister to reconsider such a decision and, if necessary, to the Administrative Appeals Tribunal ("AAT") which can conduct a full merits review of the decision. Initial planning decisions, including those refusing to grant an FRC or licence are not currently reviewable by the AAT.

The House of Representatives Standing Committee on Transport Communications and Infrastructure recently recommended that the use of FRCs be discontinued and that users wishing to reserve spectrum should be issued with a licence after submitting a plan which outlines the timescale for full utilisation.

The *Radcom Act* gives essential power to the Government in the long term to reorder the radio spectrum for new priorities and to raise spectrum productivity. The Minister has the authority to publish overall plans for the use of the spectrum in the Spectrum Plan, which is based on the International Table of Allocations. The National Spectrum Plan provides a strategic national overview of the uses for each band within the spectrum. It is regularly revised to reflect any changes in the international arena, variation in strategies agreed to by Government in the national arena and technical developments.

Band Plans further partition the allocations defined in the Spectrum Plan and specify particular services which may be licensed and their relative priority within each band. In Australia, these Band Plans define the limits of each frequency band, and also provide the basis for the development of the rules for sharing and allocating frequencies between users and uses.

Spectrum planning in Australia determines:

- the uses for a particular band;
- the bandwidth and separation between channels; and
- the technical parameters of transmitters and receivers and whether channel sharing is to be permitted.

The management of the radio spectrum at a national level is constrained by a number of factors:

- the large capital investment required for communications networks, including equipment means that users require some form of guaranteed access to the spectrum before they are willing to undertake any form of investment in radiocommunications networks;
- the pressures for change imposed by technical innovation;
- particularly in the fields of aeronautical, defence and space communications, Australia must take account of international factors;
- large portions of the spectrum have been set aside for purposes which are deemed to be socially necessary - defence, law enforcement and public safety. These forms of communications are guaranteed access to the spectrum and as a result the amount of the spectrum available to other users and uses is significantly limited;
- international agreements on specific frequency allocation, equipment and interference (although less so than most countries).

INTERNATIONAL MANAGEMENT OF THE RADIO SPECTRUM

The International Telecommunications Union (ITU) is responsible for the appropriate co-ordination of radio spectrum use internationally. Agreements between member nations on the use of the radio spectrum are reached which become binding on those member nations. Australia has an obligation to comply with ITU conventions as they have been ratified by the Australian Government giving them the status of an International Treaty.

The International Radio Consultancy Committee (CCIR) is the permanent organ of the ITU which issues recommendations on technical and operating issues relating specifically to radiocommunications. The CCIR recommend performance standards for radio systems to ensure effective and compatible interworking in the international telecommunications arena.

ITU World Administrative Radio Conferences (WARC) are held frequently at which agreement is reached on the use of the spectrum, the way in which it will be shared and the procedures adopted to ensure that it may continue to be regulated effectively and efficiently. The outcomes of WARCs become the broad plans for all member nations and impose obligations on the use of the spectrum at a national level. The ITU WARC 92 Conference, which will take place in Spain early this year, will be reviewing the frequency allocations for mobile services, shortwave

broadcasting, sound broadcasting by satellite and high definition television Australia. Industry is currently involved, in consultation with the Department, in preparing a national brief to address issues at the Conference.

Members of the ITU retain their sovereignty to do in their own countries whatever they choose to do with the spectrum, provided that they do not compromise the ability of other states to use the spectrum in accordance with ITU agreed designations. Because of Australia's geographical isolation, we have considerable scope for greater freedom of choice in how we manage the radio spectrum within Australia, without compromising our responsibility as a member of the ITU. Australia is therefore partly, but not totally, its own sovereign authority on the allocation and assignment of frequency.

Australia sources some of its radio technology from Europe and North America. These two sources are in different ITU regions and therefore can have different band allocations. One of the major Australian spectrum management problems is to develop national Spectrum and Band Plans which accommodate rationalisation of technical differences between North America and Europe.

An increasingly important issue in use of the radio frequency spectrum will be global consistency. In the very near future, we will see a proliferation of world wide communications systems, including perhaps the Iridium system of 77 small, polar-orbiting satellites. Systems like that will require co-ordination of frequency allocation across the world. Lack of co-ordination will inhibit our ability to derive many of the benefits which these developments can otherwise provide. If such systems are forced to work in different parts of the spectrum in different places, there will at the very least be additional technical obstacles to be overcome. Furthermore, efficiencies which can be achieved through mass production of equipment for a world market are likely not to be achieved if individual national markets are differentiated according to the frequency on which they operate.

OTHER SYSTEMS OF REGULATION/MANAGEMENT OF THE RADIO SPECTRUM

There has been a growing trend worldwide to seek alternatives to the traditional system of structured spectrum allocation plan and "first come first served" assignments. New Zealand has recently introduced a property market approach to spectrum management. This approach involves the creation of titles similar to those for ownership or leasehold of land with maximum reliance on market forces to determine the use. Occupancy rights are sold or leased by the owners of those rights which are of 20 years duration. Management rights and licences are freely transferable, subject to the provisions found in the New Zealand *Commerce Act 1986*. New Zealand has already auctioned the rights to several broadcasting and cellular bands. The New Zealand *Radiocommunications Act 1989* regulates the issuing and registration of management rights and licences. The Act does not dictate the purpose for which a person may utilise a frequency once a licence has been obtained, nor does it dictate who is entitled to acquire management rights or a licence.

The market-based approach has been criticised principally on the basis that it limits Government options for the future use of the spectrum. The Government may sacrifice aims such as creating new telecommunications services at the lowest possible prices. One major criticism is that this system will favour modern corporations and will not necessarily be in the public interest. Many claim that this type of system does not necessarily minimise scarcity as the Government loses flexibility to take advantage of long term opportunities or to meet long term and international obligations.

Those who favour the market-based approach to management of the radio spectrum draw an analogy between the radio frequency spectrum and land. It is said that both are scarce resources, and that the best way of determining their most efficient use is to let the market call the shots. Of course, land use in most countries, including Australia is not left absolutely to the market. Land use is heavily regulated - there are zoning controls and requirements for building and development approval. We protect various land uses in the social interest - coastal foreshore, public recreation areas, historic sites, roads and streets. Governments in Australia have compulsory powers of acquisition of land. Federal Governments acquire land for defence or airport buildings. State Governments require land to build schools or expressways - and increasingly to enable private consortiums to do so. Even Local Governments compulsorily acquire land.

If we move to a free market approach to allocation of the radio frequency spectrum, how should it be done? Should existing users be affected? Or should it only affect future users? Should there be compulsory powers of acquisition for uses regarded as socially important - whether in the public or the private sector? Will the market encourage the efficient use of spectrum, or will it be a means of hoarding spectrum, and stymieing potential users with innovative applications, but without deep pockets, or for holding to ransom those with deeper pockets? Is the market the best judge of optimum use of the spectrum?

- Technical efficiency: the Department is constrained in its ability to ensure that the most spectrum efficient and practices are in use;

- Public and merit goods: while the current system of spectrum management meets the needs of users who provide socially beneficial services to the community and those who use the spectrum for personal non-profit purposes, there is a need to ensure efficient use of the spectrum, particularly with respect to public sector users; and

- Allocation to highest value uses: the current system of spectrum management is not able satisfactorily to allocate spectrum to the highest value uses and this problem will become critical if demand continues to increase and congestion becomes more commonplace.

The Committee examined four possible approaches to addressing the shortcomings listed above:

1. An Administrative System

   An administrative system for setting priorities for allocation and assignment was not supported. The Committee found that such an approach would not meet the objective of being flexible and responsive to changes in demand, particularly if levels of congestion were to increase. Furthermore, the potential costs associated with a system of comparative assessment for assignment could impose significant costs on spectrum management which would have to be borne by users on a cost recovery basis.

2. Fine Tuning the Current Administrative System

   The Committee found that suggested reforms to the current spectrum management system would contribute to improving the responsiveness of spectrum management to technological change and increasing demand, however, there would continue to be some essential weaknesses. In particular, the Committee stressed the following:

   (i) replanning and reassignment of frequency allocations would still be limited because of the problems associated with compensating users for the costs associated with replanning;

   (ii) there is no incentive for users to utilise spectrum in the most efficient manner possible, except the fear of losing an assignment;

   (iii) resumption is likely to be a long and drawn out process which may in fact make spectrum management even less responsive; and

   (iv) the suggested reforms do not address the need to ensure that spectrum is allocated to the highest value uses in situations where demand exceeds supply.

3. A Market Based System

   The Committee stated that tradeability of spectrum resources offers significant advantages in relation to the objectives of dynamic efficiency and technical efficiency over the current administrative approach. In particular, the establishment of a market would:

   (i) enable users to acquire spectrum or relocate to new spectrum in response to their changing needs;

   (ii) encourage users to optimise their use of spectrum in order to maximise the returns on their investment;

   (iii) provide an effective solution to the problem of compensation for users who move to new spectrum or to other means of service delivery;

   (iv) provide non-commercial users with some incentive to seek to use their spectrum more efficiently as they would be able to sell or lease out excess requirements and use the funds to finance improvements in equipment;

   (v) provide a means of recouping any economic rents from users in such a way that it does not distort investment decisions; and

   (vi) facilitate allocation to the highest value uses for commercial applications.

The Committee determined, however, that a comprehensive market based system covering all spectrum users and uses should not be introduced at the current time as there are some significant uncertainties, particularly with regard to ensuring continued access for public sector and non-profit organisations and the potential difficulties with interference.

4. A Mixed Market/Administrative System

The Committee recommended that reforms to the current system should be undertaken in parallel with the development of a market system. The Committee's approach to a mixed market/administrative system would generally restrict the tradeability of spectrum access to commercial applications in order to protect non-commercial users from premature exposure to a market based system until means have been devised to resolve current uncertainties. The Committee recommended that the Department develop an implementation strategy for a mixed market/administrative system and that this proposal be developed in parallel with recommendations for change to the current administrative system. The Committee also recommended that non-commercial users should have the choice of remaining under the current administrative system or having their licences converted to a tradeable resource. Other recommendations included that a system of regular auditing of spectrum used by public sector users be introduced and that tradeable spectrum access should not be perpetual, but should provide tenure for a fixed term.

The Government is yet to respond to the Parliamentary Committee's recommendations but the expectation is that the Government is likely to be strongly guided by the Committee's detailed report and proposals. A Government response is expected in late 1991 or early 1992.

THE BROADCASTING SERVICES BILL

Recent months have also seen proposed radical changes in the management of the allocation of radio frequency spectrum affecting Australian broadcasters. In November 1991 the Commonwealth Government released the *Broadcasting Services Bill* for public comment. That exposure Bill proposes sweeping reforms to all aspects of Australian broadcasting regulation, including the abolition of the Australian Broadcasting Tribunal and its replacement with the Australian Broadcasting Authority ("ABA") and the conferral on that body of a wider range of functions than is currently vested in the ABT, including planning functions relating to frequency allotment for particular broadcasting services. In discharging its planning and licensing functions, the ABA will be under a statutory obligation to ensure maximum use of the radio spectrum is made, a requirement which is likely to lead to greater competition in the broadcasting industry.

A streamlined regulatory approach has been proposed which includes:

- a simplification of the licensing criteria, with the only key criteria being the suitability of the licensee;
- a simple licence allocation process in most cases, although community licences will still involve merit-based gains;
- virtually automatic licence renewals; and
- class licences for all narrowcasting services and non-satellite pay services, in accordance with the telecommunications model.

Under the proposed Bill, the licence allocation process will be preceded by a planning process, involving the following four stages:

1. Assignment of radio frequency spectrum by the Minister to the broadcasting services band (with a ministerial power to reserve part of that band for national and community broadcasters);
2. The ABA is to set priorities for the development of frequency allotment and licence area plans;
3. Frequency allotment plans specifying the frequencies available in various parts of Australia for broadcasting services are to be developed by the ABA; and
4. The ABA will have discretion to determine licence area plans for the purpose of allocating all available spectrum capacity.

Commercial radio and television licences are to be allocated according to a price-based competitive system. The particular system to be adopted is within the discretion of the ABA, subject to any directions issued by the Minister. Such a system already operates under the National Metropolitan Radio Plan, which permits conversion of two AM radio licences to FM under a tender system for each capital city.

In transferring responsibility from the Minister to the ABA for planning designated parts of radio frequency spectrum, the Bill seeks to introduce greater transparency and accountability for planning decisions by obliging the ABA to conduct public consultation processes. While moves towards increased public participation in planning processes and wider public accountability are welcome, fundamental issues are raised regarding the appropriateness of vesting in a single administrative body such a diverse range of legislative, administrative and quasi-judicial functions. The ABA's proposed planning and licensing functions are especially controversial in posing a challenge to established concepts of the separation of powers enshrined in the Australian Constitution. These and other aspects of the Bill are likely to be the subject of extensive public comment during the next few months. Public comment on the Bill is scheduled to conclude in February 1992 with the current expectation being that the Bill will be considered by the Federal Cabinet some time during March, prior to its introduction in Parliament and expected passage in mid-1992. If that timetable is adhered to, and there must be some doubts that it will given the recent change in Ministerial personnel affecting the broadcasting portfolio, Australia could witness the implementation by mid-year of the most radical changes to broadcasting and radiocommunications regulation seen in that country for decades. Such major reforms would sit aside alongside the equally bold reforms enacted by the Australian Parliament earlier this year in relation to telecommunications.

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* The research assistance of John Mackay, solicitor, Blake Dawson Waldron, is gratefully acknowledged.

NEW OPPORTUNITIES IN AUSTRALIAN TELECOMMUNICATIONS

SPEECH FOR THE PACIFIC TELECOMMUNICATIONS COUNCIL PTC'92

13 JANUARY 1992

ANDREA GROSVENOR
Assistant Director
Regulatory Policy Section
Telecommunications Policy Division

11.0

NEW OPPORTUNITIES IN AUSTRALIAN TELECOMMUNICATIONS

At PTC'91, Vanessa Fanning of the Australian Department of Transport and Communications introduced the Australian model for telecommunications reform. At that stage, the policy decisions had been made, and the implementation was about to begin. Today, all of the necessary legislation and most of the procedures to give effect to the policy decisions are in place, and Australia's second carrier has been named.

The change process has not been an easy one. The level of consultation with all affected parties has been unprecedented in Australian legislative reform, with exposure drafts of all of the major pieces of legislation and many of the subordinate instruments being widely circulated for comment before finalisation. This has helped to some extent to "sell" the changes to the industry and the community, and it also provided much useful input to the drafting process itself, with many of the suggestions received during the consultation phases being incorporated into the final products.

The changes and their implementation has also faced considerable opposition. The most contentious issues were the terms for interconnection between the existing carrier and the new carrier; the rapid establishment of real competition across the range of telecommunications services; the protection of consumers; and the merger of Australia's domestic and international carriers.

The Government policy decisions that were implemented in 1991 build on and extend the reforms that commenced in the mid-1980s. Major policy objectives include: promotion of competition and fair and efficient market conduct; efficient, accountable and responsive telecommunications carriers; Australia-wide access to the standard telephone service; development of Australia's telecommunications capabilities, industries and skills; and a framework which is sufficiently flexible to accommodate developing technology.

The 1990-91 reform package will further the establishment of an open, pro-competitive telecommunications regulatory environment, one which we believe to be among the most progressive in the world.

The main elements of the 1990-91 reforms are:

. the introduction of a transitional duopoly in network services provision through the licensing of a second network operator, based on the sale of AUSSAT, the domestic satellite carrier;

- the implementation of pro-competitive safeguards, including equal access and interconnection between the carriers;

- the issuing of three public mobile telephone service licences, one each to the existing and the second carriers, with the third to be issued by the end of 1992;

- the merger of the Government's domestic and international public network operators, Telecom and OTC, to form the Australian and Overseas Telecommunications Corporation (AOTC);

- the introduction of unrestricted network competition from 1997;

- open competition in the provision of public access cordless telecommunications services (or CT2);

- full resale of domestic and international capacity; and

- a mandate for the telecommunications regulatory authority, AUSTEL, to promote competition.

The second general and mobile telecommunications licences will be awarded to Optus Communications, a consortium comprising BellSouth, Cable and Wireless, and majority Australian-ownership through Mayne Nickless, AMP, National Mutual and the AIDC Telecommunications Fund. The merger of Telecom and OTC will be effected early this year, following the establishment of competitive interconnection arrangements for Optus to have equal access to Telecom's network infrastructure. This is a major step in the latest round of reforms.

I don't propose to talk in detail about the changes or the ways in which the implementation difficulties have been overcome, but will focus instead on where we see the major opportunities arising out of the reforms. Suffice it to say that we are confident that the changes will be effective, and that Australia will have a more efficient, dynamic and responsive telecommunications sector as a result.

Telecom Australia has already achieved one of the world's highest penetration rates for basic services, with 95 per cent of households having access to the network, and the Australian public's adoption of new telecommunications technologies, such as cellular mobile phones, has been among the fastest in the world. Mobile services in operation increased by 58 per cent in the year to June 1991, so that there are now nearly 300,000 mobile subscribers in Australia's population of just 17 million.

The new marketplace offers even more opportunities for all industry players. It is important to note that when we talk about the participants in the industry, we include not only the licensed general and mobile carriers, but also service providers (including resellers, value added service providers and private network operators), equipment suppliers, unions and employees within the industry, and, of course, consumers, both business and domestic.

Now let me describe some of the benefits that we envisage over the next few years.

CARRIERS

Until 1997 Australia will have two network carriers, AOTC and Optus.

AOTC

The [redacted] Government-owned AOTC will be formed by merging the pre-existing domestic and international operators. It will operate from early 1992 as a commercial enterprise across the full range of telecommunications services. It is established as a "commercial" entity, that is, as a company under corporations law, with a Board comprised of a wide range of business, industrial and legal skills, and a commercial capital structure.

Telecom is one of Australia's largest companies with total assets of $22.5 billion as at 30 June 1991. It made a net profit after tax of $869.5 million for the year ending 30 June 1991, and employs around 77,000 people. OTC Limited had total assets of $1.5 billion at 31 March 1991, and made a net profit after tax of $276.6 million for the year ending 31 March 1991. OTC employs 2,300 people. The merged AOTC will be the fifteenth largest telecommunications company in the world.

The Government's intention in merging Telecom and OTC amounts to much more than merely rationalising the assets, resources and businesses of the two enterprises. The aim is to create an Australian telecommunications company that is genuinely internationally competitive. Its established position in the domestic market provides a strong base from which to expand internationally. The introduction of competition will also stimulate it to become more efficient and commercially-oriented.

The present Australian Government has decided to retain AOTC in government ownership, although it is the publicly stated intention of Australia's other major political parties to privatise AOTC in the event that they win Government in the next election, due in 1993.

Optus

Optus will receive its carrier licences on closure of the sale of AUSSAT, which we anticipate being on 31 January. Optus expects to commence operations with the resale of mobile capacity from Telecom's AMPS network within about four months, and to start offering other services in the fourth quarter of this year.

A prime reason for international interest in the second carrier licence is the strategic position of Australia's current network and regulatory regime. Australia also provides Optus with an excellent base for continued technological development, access to the emerging world markets (particularly Asia), and a regulatory environment at the forefront of international trends towards deregulation.

The opportunity to build a second network operator almost from scratch with full interworking with the established network and no regulatory restrictions on technology, services or market coverage has rarely arisen, but the future development of telecommunications elsewhere is likely to provide other opportunities to do so. Those who have learned in Australia will be well placed to transplant their knowledge.

In addition to the $A800 million that it is paying to buy AUSSAT, Optus has indicated that it will invest $A2 billion over the next six years in establishing operations in Australia. The investment scheme includes plans to draw in local industry and achieve a local content level of 70 per cent over the next five years. The plan also incorporates $A15 million for a training institution, another $A100 million for training costs and an additional $A50 million on research and development. Optus expects to create over 5000 direct jobs in Australia.

Competitive Safeguards

The Australian regulatory model for managing the transition from a monopoly to a competitive telecommunications market offers Optus the opportunity to become a significant operator in the Australian market in quite a short period of time. There is no question that AOTC has strong advantages in areas such as customer base, infrastructure and access to information. These advantages had the potential to be used to inhibit the development of widespread competition and restrict competitive entry to the market by the second carrier. Overseas experience showed us that without equal access safeguards, the introduction of competition is likely to be at best slow and limited.

The benefits of a competitive telecommunications market best flow to the community when there is real pressure on

the carriers to reduce prices, increase service offerings and improve their responsiveness to customers' needs. Optus must be given the opportunity to establish a significant presence in the Australian market to provide genuine competition to AOTC.

The Australian Government decided that the best way to achieve a deregulated, competitive structure for the long-term was to implement specific pro-competitive regulation for the short-term. The package of competitive safeguards introduced into the Australian legislation includes measures relating to the interconnection of the second carrier to Telecom's infrastructure, customer access, numbering, directories and the regulation of cross-subsidy and accounting separation.

Many of the special conditions applicable to Optus in the first instance will cease to apply when AOTC's market dominance is significantly reduced. For example, the initial regulated charge for Optus to interconnect to the AOTC network is set to cover the long-run marginal cost of providing the service to Optus and will apply in areas where AOTC maintains market dominance or bottle-neck power. Subsequent interconnection charges are to be commercially negotiated between the carriers.

Global Focus

While the primary focus of most large carriers has traditionally been on their home markets, leading carriers are now seeking to build global businesses by bidding for contracts to design, build and operate networks in international markets. International activity is necessary today in order to maximise growth and shareholder returns, and the demand by consumers for access to the best new technologies ensures that markets are available. Keeping up with the technologically-affluent Joneses is an important aim of any country wanting to be a player in the international economy today. It's not just access to the technology that is important, however. Governments are increasingly aware of the benefits of encouraging competition in their domestic markets in order to strengthen their global position.

Leading carriers are motivated by a need to secure sufficient scale to buy equipment and services efficiently, fund R&D programs and serve customers world-wide. For AOTC and Optus to be at the industry forefront, they too will need to pursue international markets, especially in the rapidly growing Asia/Pacific region.

A recent study by Australia's Allen Consulting Group, commissioned by the Australian Department of Industry, Technology and Commerce, estimated that by the year 2000 the total revenues of Australian-based carriers could

approach $A50 billion, nearly half of it generated off-shore.

AOTC will succeed in international markets on the basis of Telecom and OTC's reputations for being smart developers and operators of the latest technologies and good managers of large scale networks. For example, at last year's Oracle Users' Asia-Pacific Conference, Australia's OTC's Oracle database for its intelligent network management system was judged the best in the Asia-Pacific. Aside from the advanced networks they operate in and from Australia, Telecom and OTC have significant involvement in operating networks in other countries, including Saudi Arabia, Vietnam and Pakistan.

Optus has indicated through its development and investment plans that it will be competitive both domestically and internationally. This is also evident in the Optus consortium members' records of competitiveness both in telecommunications markets and in their respective industries.

SERVICE PROVIDERS

Australia should be well placed to play a significant role in providing global telecommunications services, particularly to the Asia/Pacific region. The Australian carriers are innovative and have many leading edge capabilities to offer in the areas of network and mobile services. Huge growth is also anticipated in the export of value added and professional services, for example, software, electronic data interchange and facilities management. Australian service providers can access international markets through network operation, strategic alliances, direct investment or hubbing.

Australia has a growing and competitive market for value added and other telecommunications services. Since the opening of provision of value added services to full competition in 1989 a broad range of innovative services has been established.

This sector is expected to grow further with the removal of restrictions on third party resale of telecommunications capacity. Private network operators may now make the most efficient use of their networks by disposing of or sharing spare capacity, and their customers can take advantage of access to a wider range of private network services.

The decision to allow resale is a very significant liberalisation, and it is fair to say that Australia's approach to resale is possibly the most liberal in the world. The new arrangements allow Australian service providers to resell capacity for both voice and data services and to engage in both value added and "simple"

resale. This applies to the resale of international as well as domestic services.

Australia anticipates that its acceptance of international resale will also contribute to hastening the now much-needed reform of the traditional international accounting and settlement rate regime that is serving to distort seriously the economics of international telecommunications services.

The Australian Government is aware that there are some risks in unilaterally pursuing an open resale regime, particularly if this could lead to foreign telecommunications operators, operating under less liberal regimes, being able to take unfair advantage of Australian carriers or service providers. It has therefore directed the regulatory authority, AUSTEL, to provide safeguards in certain cases, set out in an AUSTEL class licence. Class licences are designed to allow the maximum flexibility to service providers, while at the same time ensuring that minimum technical standards are maintained, and that the practical value of the carriers' reserved rights are not unduly eroded. It is a passive licensing system in that applicants don't need to make a licence application and wait for an approval, they simply need to comply with certain simple rules of conduct.

WIRELESS AND MOBILE SERVICES

Cellular mobile telephone services are becoming highly important in their own right and also as a complement to basic services in the Asia/Pacific region. While mobile has until recently been viewed as a specialised service, more extensive wireless communications services hold out the potential to provide a systemic alternative to the wired PSTN through the development of personal communications networks, wireless PABXs and other developing technologies.

In Australia we are expecting to see the new telecommunications operators make use of wireless technologies as one way of rapidly differentiating themselves and their services from AOTC. At the same time, AOTC will be working hard to develop and implement the much sought after universal personal telecommunications system. Regulatory systems which can impede the introduction of new technology, such as the spectrum allocation system and type approvals procedures, are being overhauled in tandem with the wider telecommunications reforms.

An analogue cellular mobile telecommunications service was established in Australia by Telecom in February 1987. In geographic terms, it is the largest single cellular mobile system in the world, covering most of the inhabited parts of Australia. Digital services, based on the European GSM

standard, will be introduced from 1993. The existing analogue service will be phased out progressively between 1996 and the year 2000. There will be a period of overlap between analogue and digital technologies to provide customers with adequate time for conversion to the new technology.

AOTC and Optus have been granted mobile licences. A third public mobile licence is to be issued by December 1992 for commencement of services in July 1993. The issue of any additional mobile licences will be considered in 1995.

Until it has its own digital cellular infrastructure in place, Optus will have access to Telecom's network and will resell airtime. Both AOTC and Optus will be installing GSM networks over the next few years.

The Australian mobile market will provide one of the first large-scale GSM developments outside Europe and thus will ensure that international attention is focussed on us as we establish and "road test" our system. In view of the track record of Australian industry in adapting and inventing ingenious solutions for our geographic conditions, there are bound to be many interesting developments of the mobile networks. Telecom particularly has already found that it can export expertise to countries with similar conditions, turning "problems" into "opportunities". Its international arm, Telecom Australia (International), has recently taken a controlling stake in the private sector company, Uni-Net, to build and operate a two-way radio network, a paging network and a radio telephony system in rural Poland, using Australian developed technology.

Public Access Cordless Telecommunications Services (PACTS)

PACTS, using the current CT2 standard approved by AUSTEL, are expected to fill a niche between public mobile telecommunications services and public pay-phones. These services can be provided by current and emerging technologies and complement the expanding fixed telephone network.

The supply of PACTS is fully open to competition. PACTS operators are subject to a class licence administered by AUSTEL. The class licence sets out the terms and conditions which must be complied with by the PACTS suppliers. An exclusive spectrum allocation of 861-865 MHz has been allowed for PACTS. The usage of this band will be reviewed by January 1994.

To date there are no PACTS services operating in Australia, however OTC International, in partnership with Chevallier Telecommunications, has been granted one of four CT2 licences in Hong Kong. Telecom has not yet announced its plans for any domestic PACTS operations.

EQUIPMENT SUPPLIERS

From an equipment supplier's point of view, AOTC's implementation of advanced technologies and R&D capabilities are important factors in the supplier's commitment to maintain and expand their Australian activities and develop their export potential. To remain world class suppliers, many multinationals recognise that they need to locate research and production facilities close to leading edge customers such as AOTC, and need to maintain their strategic relationships. Some have noted that being a supplier to Telecom and OTC is an advantage when they are bidding for contracts with carriers in other countries.

Telecom and OTC are currently consolidating long term network system/supplier relationships. It is likely that AOTC's choice of suppliers will remain the main determinant of supplier market share, entry and exit. Telecom now deals primarily with Ericsson, Alcatel Australia and NorTel for switching equipment, and Ericsson, Alcatel, NEC, Fujitsu and Siemens for transmission systems.

Optus has secured deals with NorTel and Nokia for switching systems and radio equipment respectively. Nokia plans to establish an Australian centre for research into indoor cordless and micro-cellular telecommunications systems.

Industry Development Policy

The Australian Government is keen to promote the commercially sustainable development of Australian industry in order to achieve forecast growth in exports of $2 billion in this industry. It is committed to a framework for the development of the industry, including:

- maintenance of a quality network;
- promoting the liberalisation of international telecommunications goods and services markets in multilateral and bilateral forums;
- promotion and maintenance of long-term strategic relationships between the carriers and global equipment suppliers. This could involve world or regional mandates in switching, transmission and network management;
- support for the development of new innovations in software and R&D skills in telecommunications;
- endorsement of local industry through Government purchases of telecommunications services and equipment; and

- consultation between the Federal and State Governments in the development of a national approach to industry.

Telecom has had a long term commitment to the Australian telecommunications equipment industry. This has been commercially driven, and Telecom has seen close links with local industry as a sensible way to do business. AOTC will continue to support the industry development fostered by Telecom and OTC, and will submit an industry development plan to the Government later this year.

Optus will be working to ensure that tangible benefits flow from the corporation's preferred supplier agreements, which will provide for technology transfer between international vendors and local suppliers, research and development and substantial local manufacturing.

There are plans to establish a Bell Northern Research laboratory at Australia's Wollongong University with responsibility for R&D into advanced personal communications and wireless/fixed network integration as well as advanced intelligent network systems.

Optus has forecast that its commercial supply arrangements and partnerships will lead to 70 per cent of its total capital program for network development being sourced in Australia.

CONSUMERS

The Australian public has a healthy scepticism of Government-directed change to institutions which the community has come to know and rely upon. While complaining about Telecom has become a national pastime, many interest groups have expressed concern about the changes being made. They needed to be convinced that positive outcomes for the community as a whole would result, and that the level of service available to the ordinary domestic consumer would not fall, nor prices rise. The rural population, which has traditionally enjoyed considerable cross-subsidisation of the cost of their telephone access, was concerned that a fully commercial telecommunications enterprise would not treat them so favourably.

At the time the new telecommunications policy structure was being developed in 1990, the then Australian Prime Minister gave a public undertaking that no rural or household user would be disadvantaged. Partly to achieve this, price caps have been applied to AOTC's domestic service rental, and local, trunk and international calls. Further real price reductions will be achieved through productivity improvements, benefiting all consumers.

At the same time, the Government has maintained its emphasis on continuing to provide all Australians with access to a standard telephone service. A legislated obligation to continue to provide universal service has been placed on AOTC. Any genuine commercial losses associated with this system will be funded by both carriers in proportion to their traffic.

In view of the virtual universal access that Australians now have to a telephone, the policy focus has shifted away from this goal and onto equity issues, that is, ensuring that the basic service is delivered as equitably and efficiently as possible. Ground-breaking work in Australia has resulted in a model for costing, funding, targeting and delivering community service obligations that we are confident will meet this aim. Selling this concept to some sectors of the community, including some existing carrier interests, has not been easy either.

Business users are already experiencing the benefits of competitive provision of customer equipment and some services through lower prices and greater choice. As telecommunications becomes a larger and larger proportion of a business's expenditure, the need to reduce this input cost of doing business becomes more important. And as the world becomes the local marketplace, it is vital that businesses have access to high quality, instantaneous, global telecommunications facilities.

The liberalisation that has occurred in Australian telecommunications since 1989 has made the business community more aware and more demanding of the best in telecommunications goods and services. We believe that the framework we are establishing will encourage carriers and service providers to meet these needs.

CONCLUSION

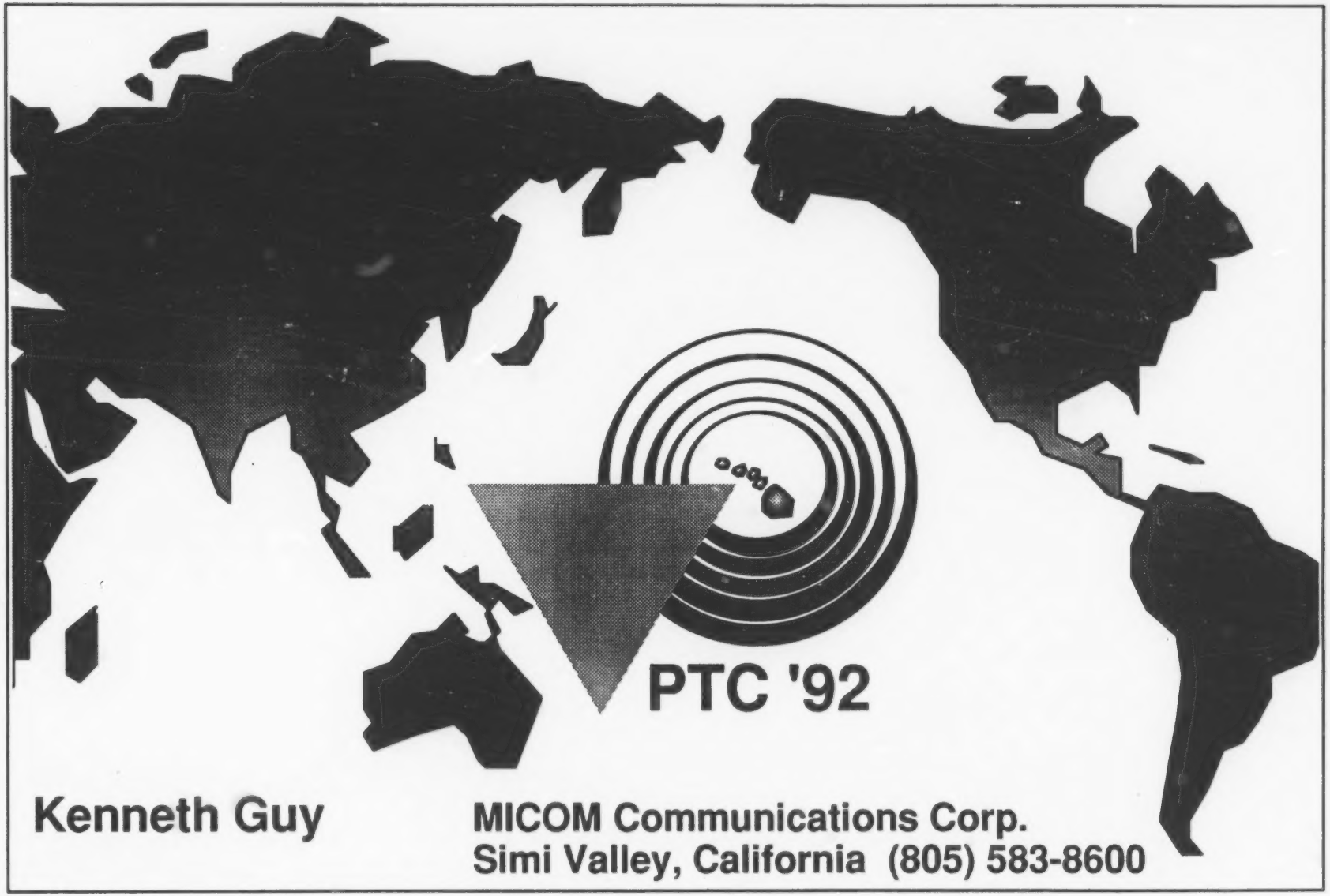
The telecommunications industry of the future is a global one, and it is user-driven. Australian telecommunications reforms since 1988 have consistently recognised the importance of positioning our industry - carriers, service providers and manufacturers - in a competitive position in the world market.

With an eye to strong and genuine competition in the longer term, the Government has decided to move from a monopoly structure to full and open competition in 1997 by way of a regulated transitional duopoly. This transitional stage will enable the new Government carrier AOTC to consolidate, and will ensure the emergence of a second carrier which is a real competitive force. The Government is confident that consumer benefits will flow from increased competition. Nevertheless, a range of measures, including regulation of the dominant carrier's prices and AUSTEL monitoring, will

safeguard the interests of all users. This is a win-win game.

The new environment is also outward-looking. As a result of increased national competitiveness, international investment and the dismantling of regulatory barriers, the Australian telecommunications industry will become more export-oriented and better positioned to take advantage of the opportunities of the 1990s and beyond. The new environment encourages carriers, service providers and equipment suppliers to go out and win business overseas. Complementing these changes in the "local environment", the Government actively supports further liberalisation of the international telecommunications market.

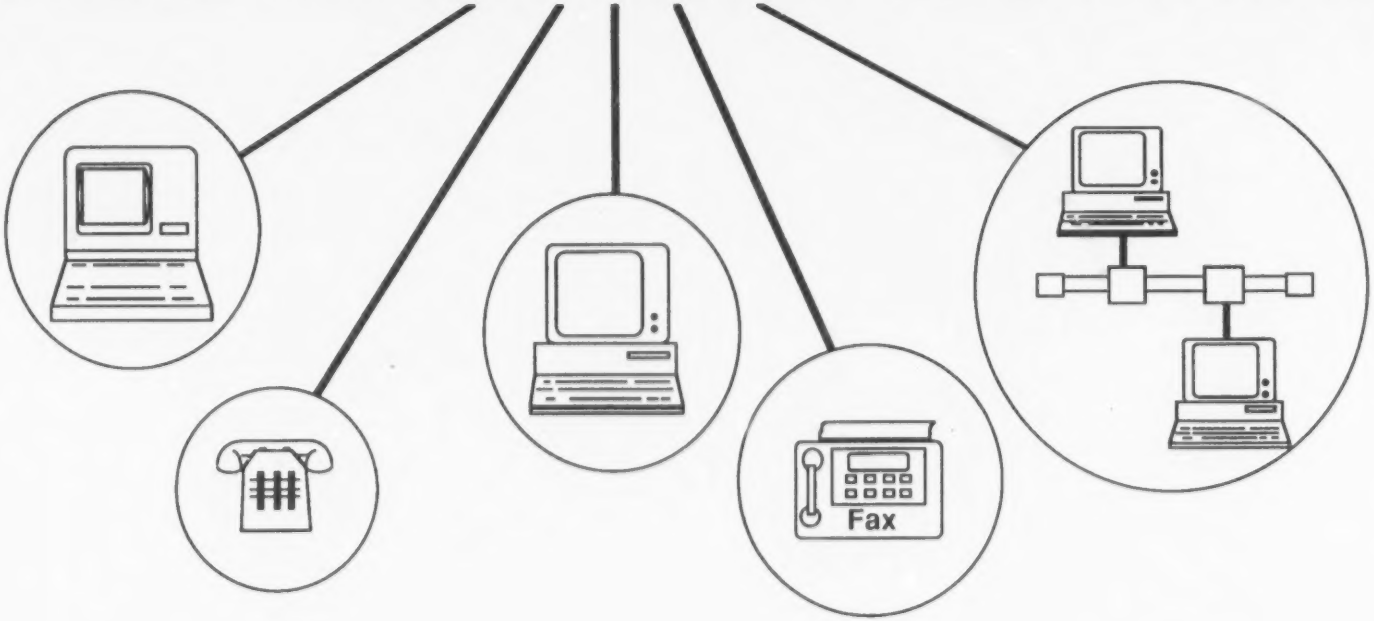
Within this context, the Australian approach to telecommunications reform is a different model from any undertaken elsewhere in the world to date. We know that many other countries, looking to move from a regulated to a competitive telecommunications market, are watching the progress of our regulatory framework with great interest. We are confident that it will deliver the goods.



Kenneth Guy

MICOM Communications Corp.
Simi Valley, California (805) 583-8600

THE NEW RULES OF WIDE AREA NETWORKING



THE NEW RULES OF WIDE AREA NETWORKING

How Every Company Can SAVE MONEY

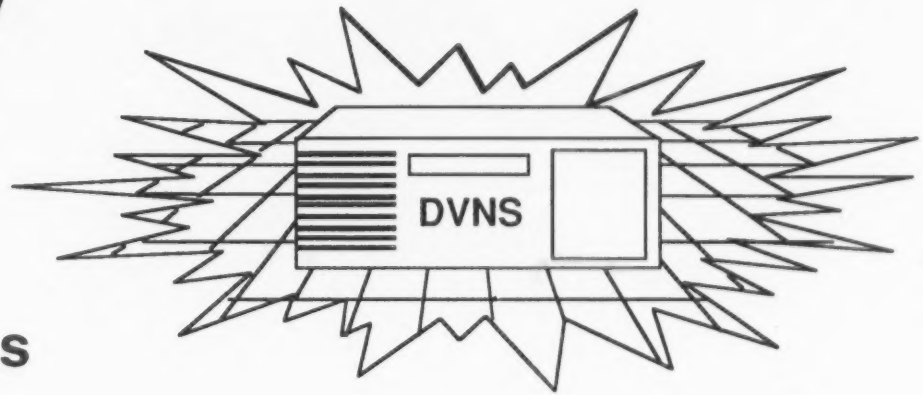
By Integrating Remote-Site Data, Voice, Fax and LAN Communications Over Low-Cost Leased Lines

1127

1128

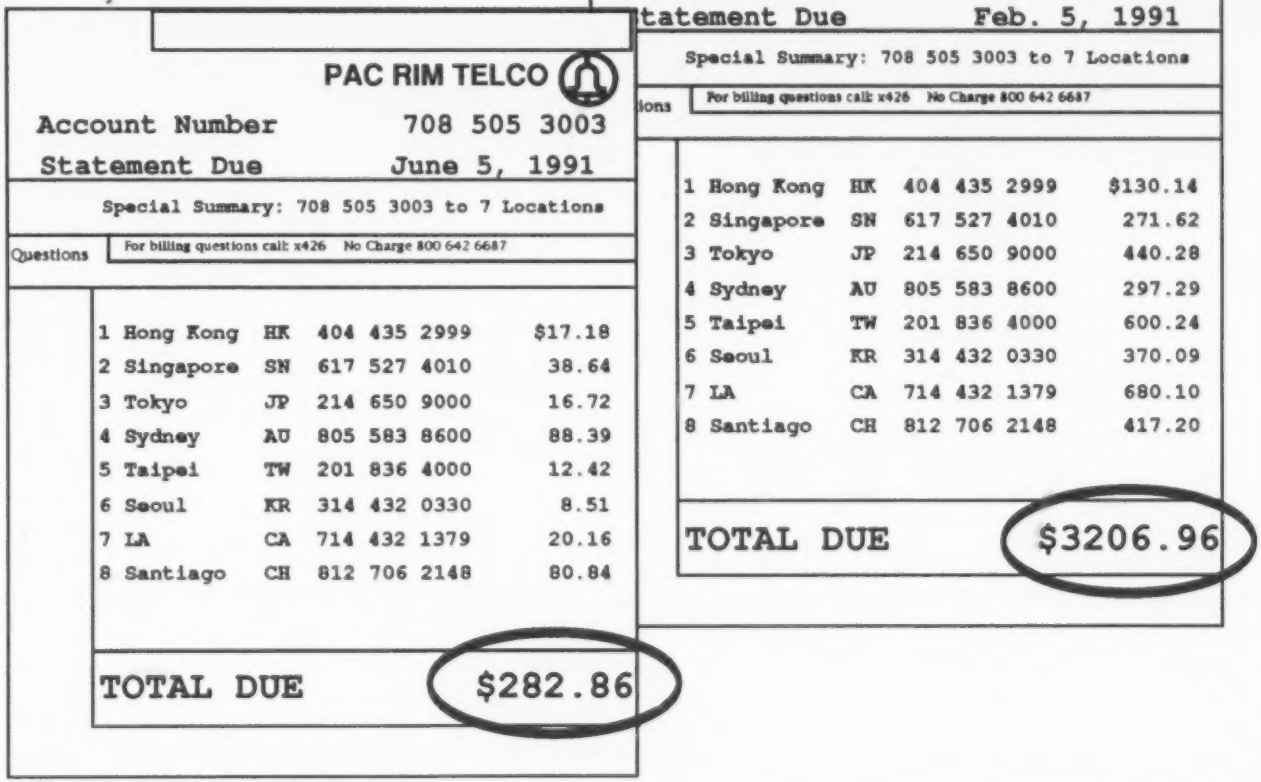
WHAT'S NEW ABOUT THE NEW RULES?

- A New Networking Concept
- New Technology
- New Products
- New Applications



WHAT'S NEW ABOUT THE NEW RULES?

- **New Savings**



PAC RIM TELCO

Account Number 708 505 3003

Statement Due June 5, 1991

Special Summary: 708 505 3003 to 7 Locations

Questions | For billing questions call: x426 No Charge 800 642 6687

1	Hong Kong	HK	404 435 2999	$17.18
2	Singapore	SN	617 527 4010	38.64
3	Tokyo	JP	214 650 9000	16.72
4	Sydney	AU	805 583 8600	88.39
5	Taipei	TW	201 836 4000	12.42
6	Seoul	KR	314 432 0330	8.51
7	LA	CA	714 432 1379	20.16
8	Santiago	CH	812 706 2148	80.84

TOTAL DUE $282.86

PAC RIM TELCO

Account Number 708 505 3003

tatement Due Feb. 5, 1991

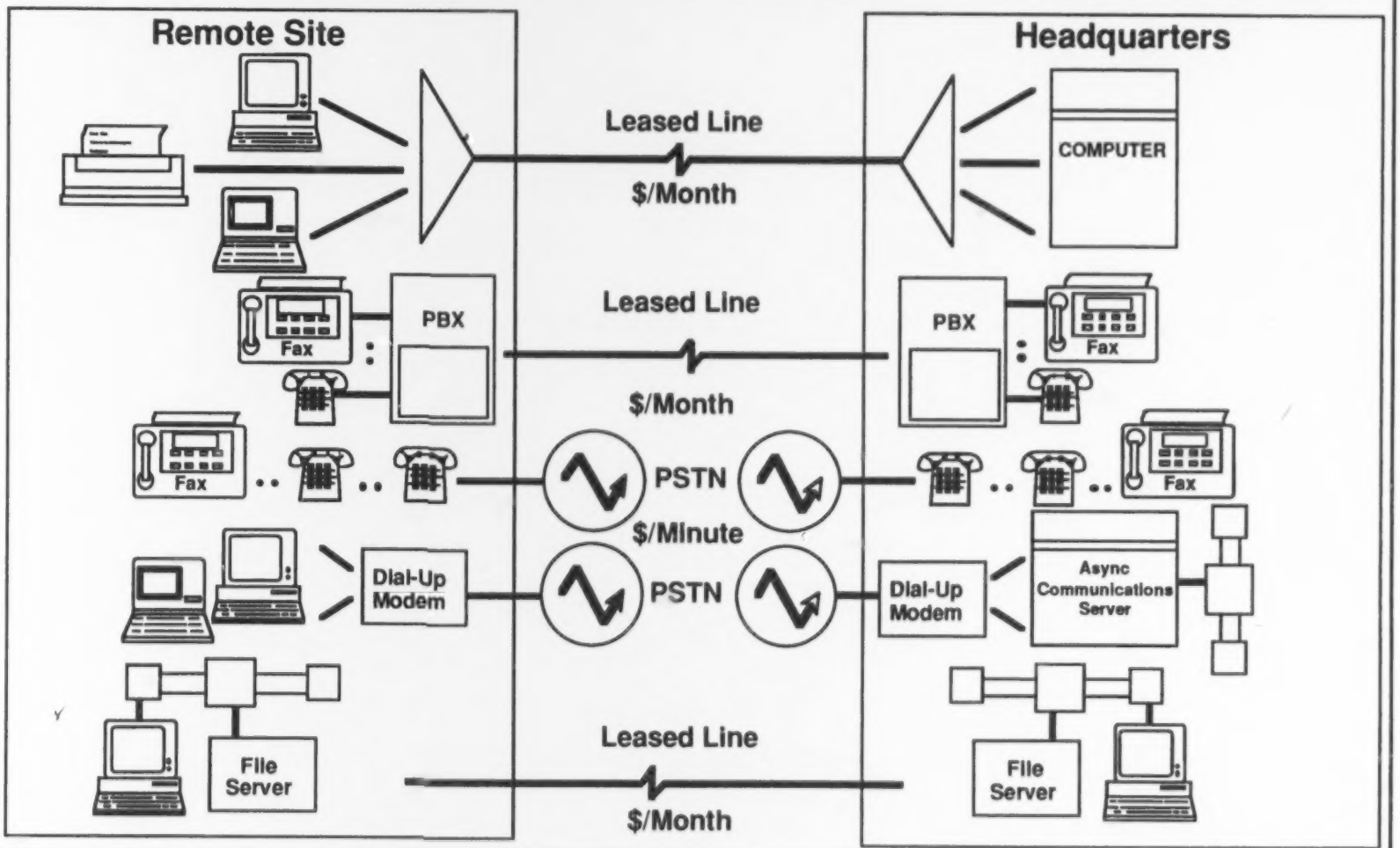
Special Summary: 708 505 3003 to 7 Locations

ions | For billing questions call: x426 No Charge 800 642 6687

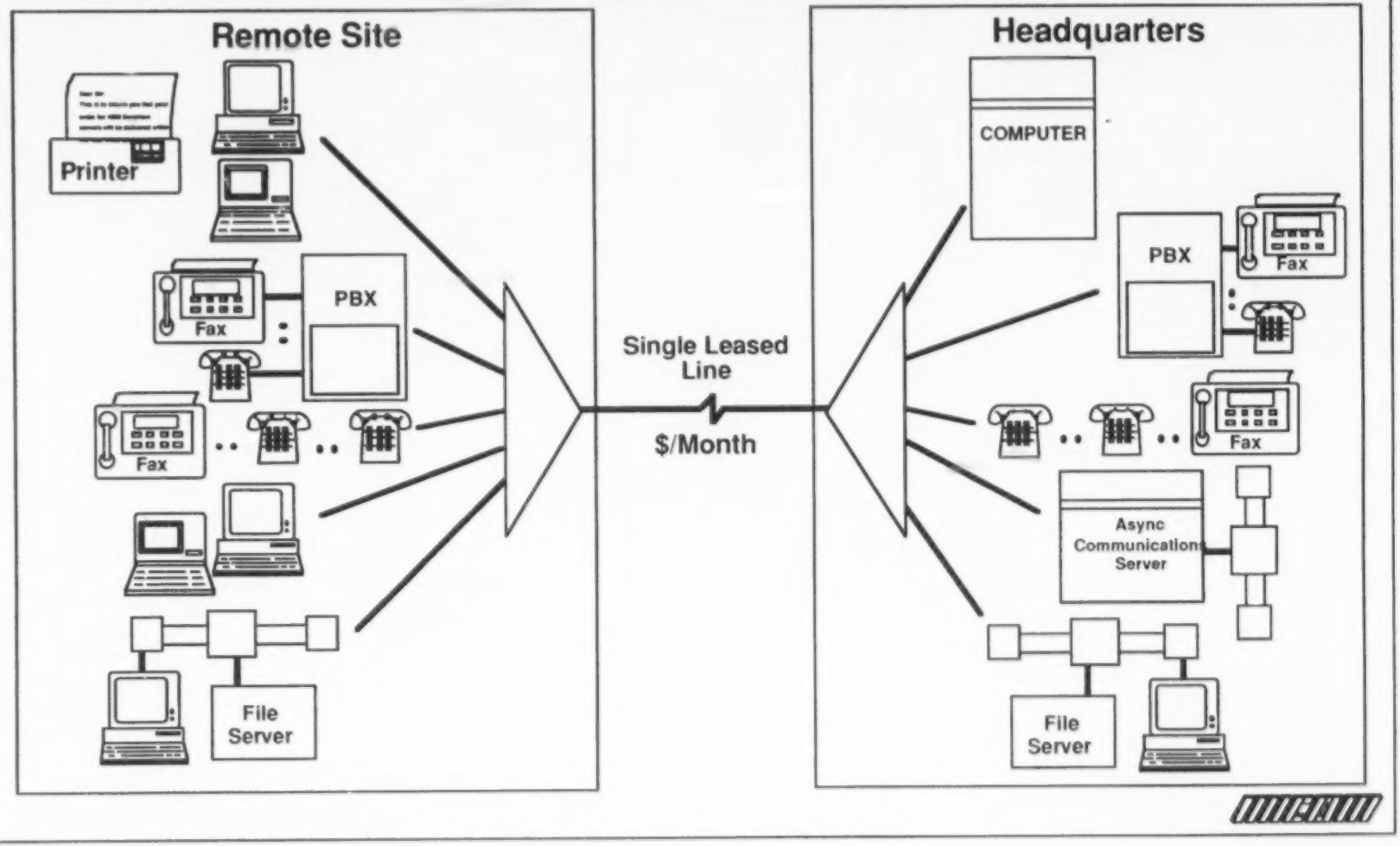
1	Hong Kong	HK	404 435 2999	$130.14
2	Singapore	SN	617 527 4010	271.62
3	Tokyo	JP	214 650 9000	440.28
4	Sydney	AU	805 583 8600	297.29
5	Taipei	TW	201 836 4000	600.24
6	Seoul	KR	314 432 0330	370.09
7	LA	CA	714 432 1379	680.10
8	Santiago	CH	812 706 2148	417.20

TOTAL DUE $3206.96

UNINTEGRATED REMOTE-SITE COMMUNICATIONS

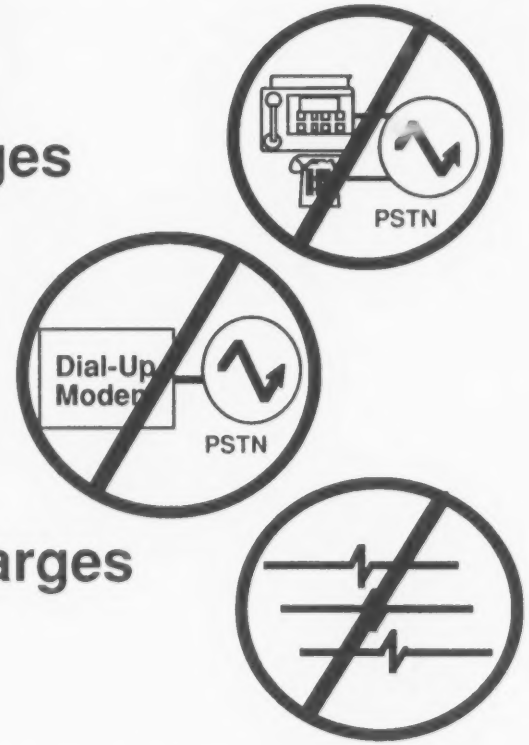


INTEGRATED REMOTE-SITE COMMUNICATIONS



INTEGRATION ADVANTAGES

- **Save Money by Eliminating:**
  - **Voice and Fax Toll Charges**
  - **Dial-up Modem Charges**
  - **Multiple Leased Line Charges for Voice and Data**



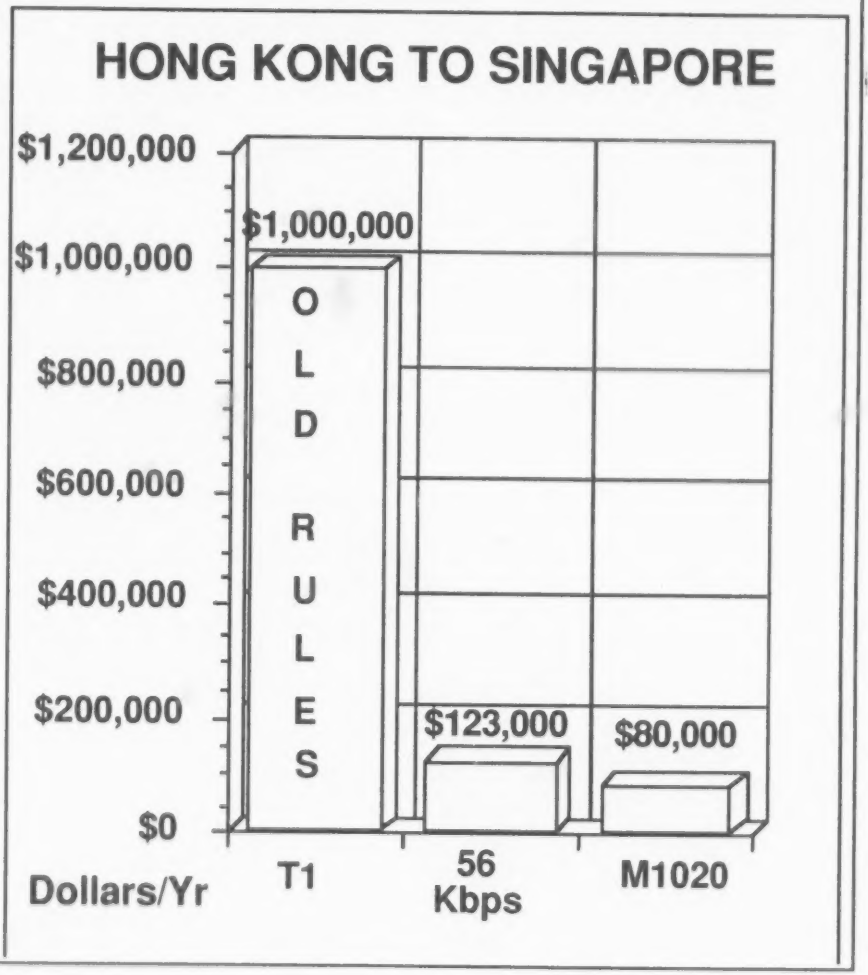
- **Other Benefits of Integrated Networking**

OLD RULES FOR INTEGRATED COMMUNICATIONS

- Use a Leased T1/E1 Line at 1.5-2 Million Bits/Second
- Use Time Division Multiplexing and Pulse Code Modulation
- Use T1/E1 Multiplexers

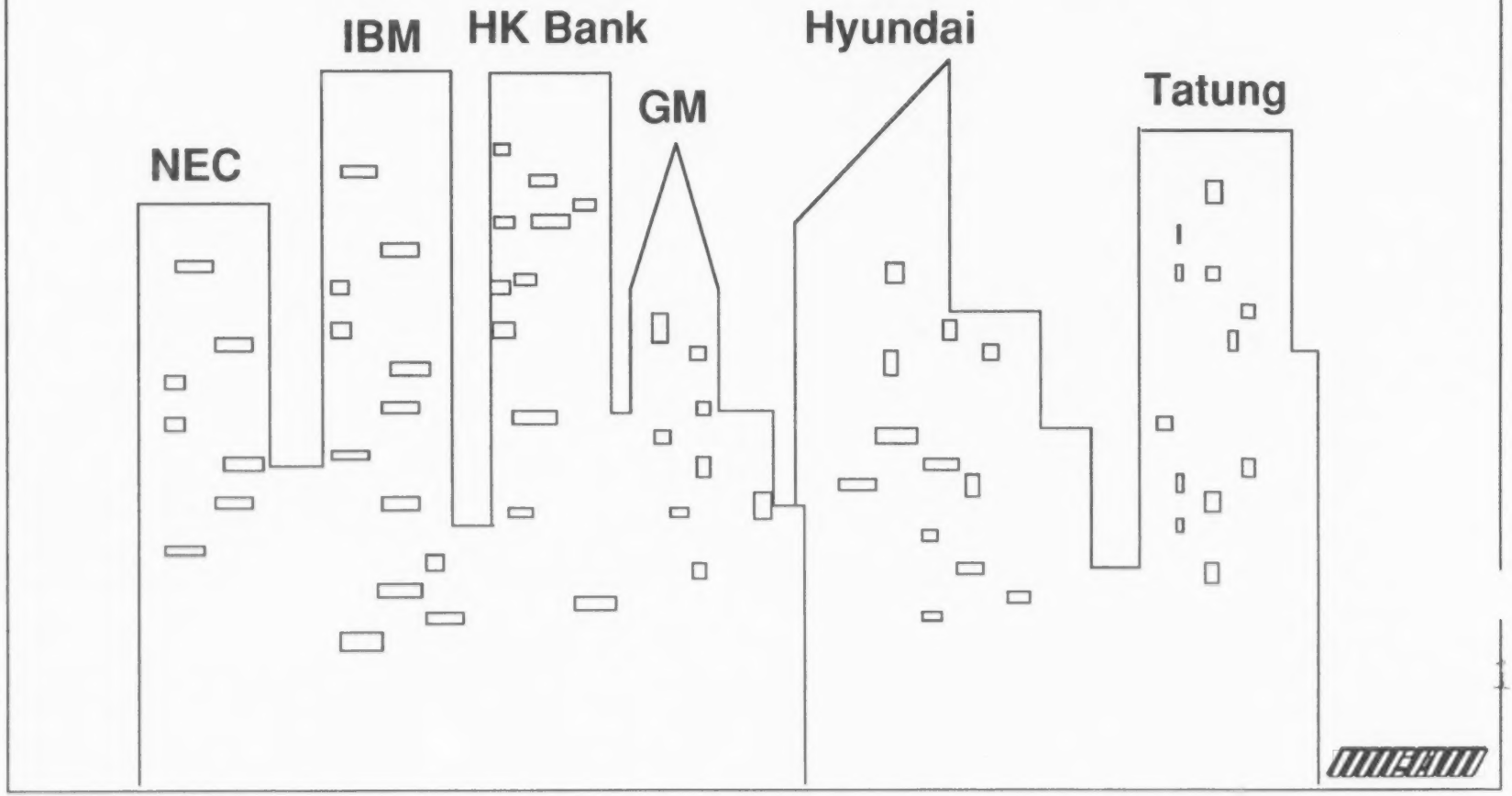
WHY DOESN'T EVERYONE INTEGRATE?

- Old Rules are Too Expensive
  - Large volume of toll traffic
    - 40 to 60 hours/day
  - 8-16 leased lines



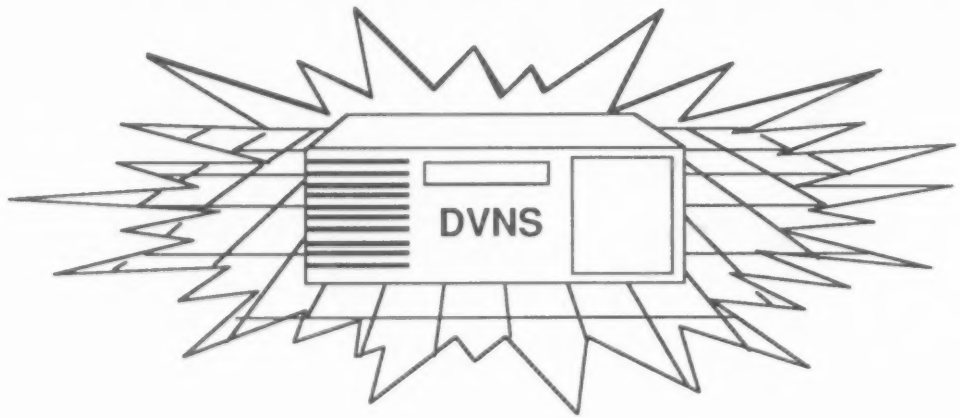
WHY DOESN'T EVERYONE INTEGRATE?

- Old Rules Only Work for Larger Companies



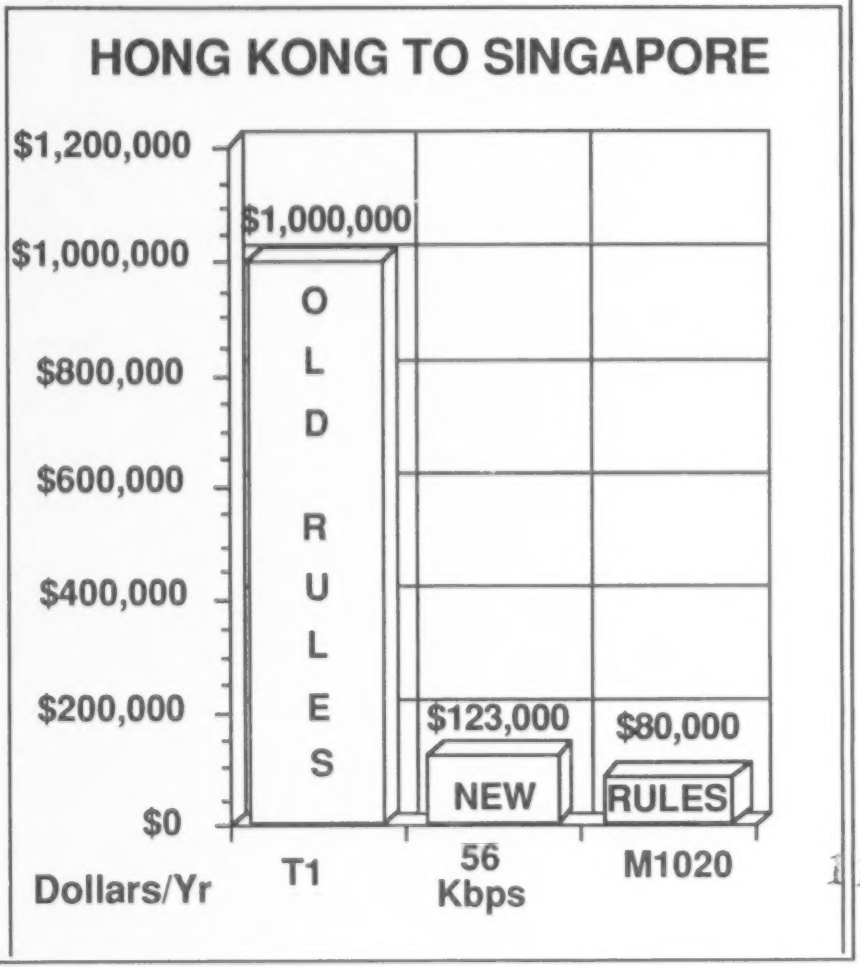
NEW RULES FOR INTEGRATED COMMUNICATIONS

- Use Low-Speed, Low-Cost Leased Lines
- Use Fast Packet Multiplexing and Advanced Compression Techniques
- Use Data/Voice Network Servers—DVNS



WHY EVERYONE CAN NOW INTEGRATE

- **New Rules are Affordable**
  - **Low volume of toll traffic**
    - **1/2 to 1 hour/day**
  - **1-2 leased lines**



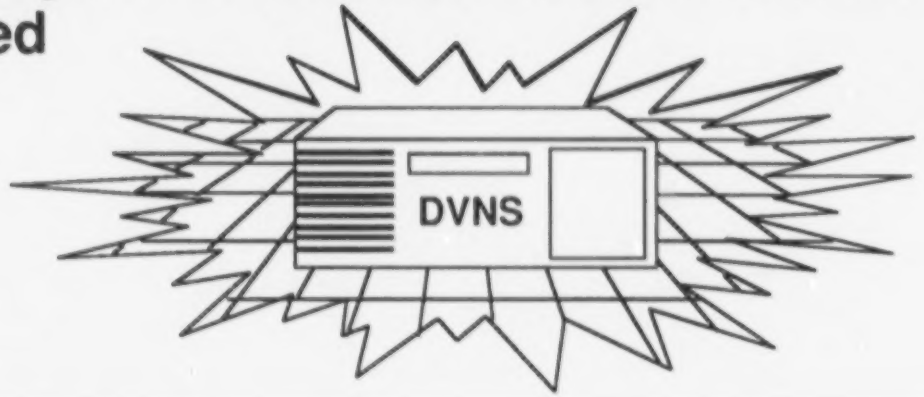
THE BOTTOM LINE

- New Technology Has Changed the Rules
- All Companies - Small, Medium, and Large - Can Now Afford to Integrate
- The Days of the Single Purpose WAN Are Over
- The Days of the Data-Only Mux Are Over

A NEW ERA OF REMOTE COMMUNICATIONS

- The Days of Multipurpose WANs Are Here

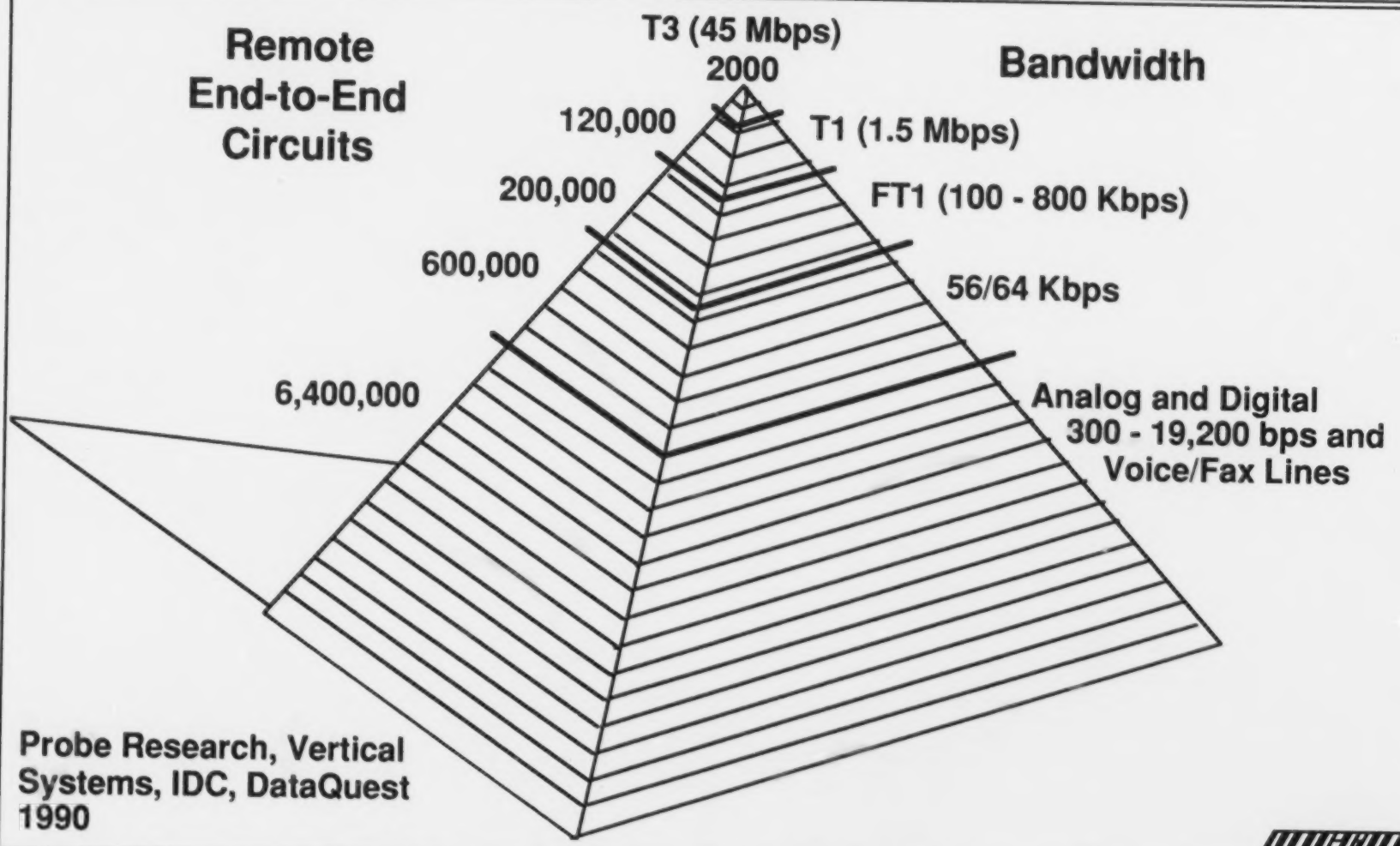
- The Days of Data/Voice Network Servers Have Arrived



DVNS USER PROFILE

- Has Leased Line for Data/LAN, and Voice/Fax Toll Calls
- Has Leased Voice/Fax Tie Line and Data/LAN Toll Calls
- Has Both Leased Line for Data/LAN and Leased Voice/Fax Tie Line
- Has Both Voice/Fax and Data/LAN Toll Calls
- Which is Your Profile?

U.S.A. LEASED LINE DISTRIBUTION



Probe Research, Vertical Systems, IDC, DataQuest 1990

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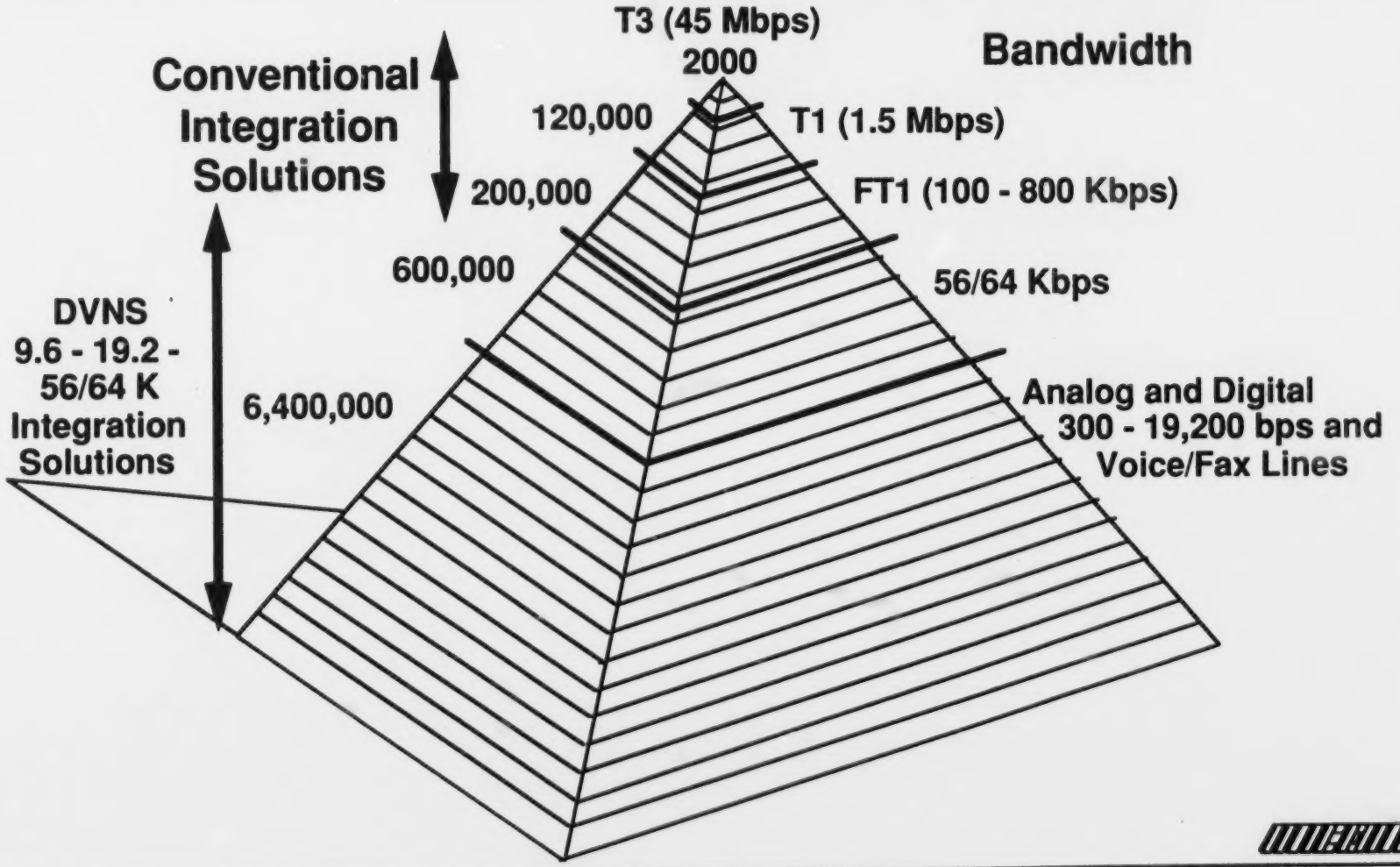
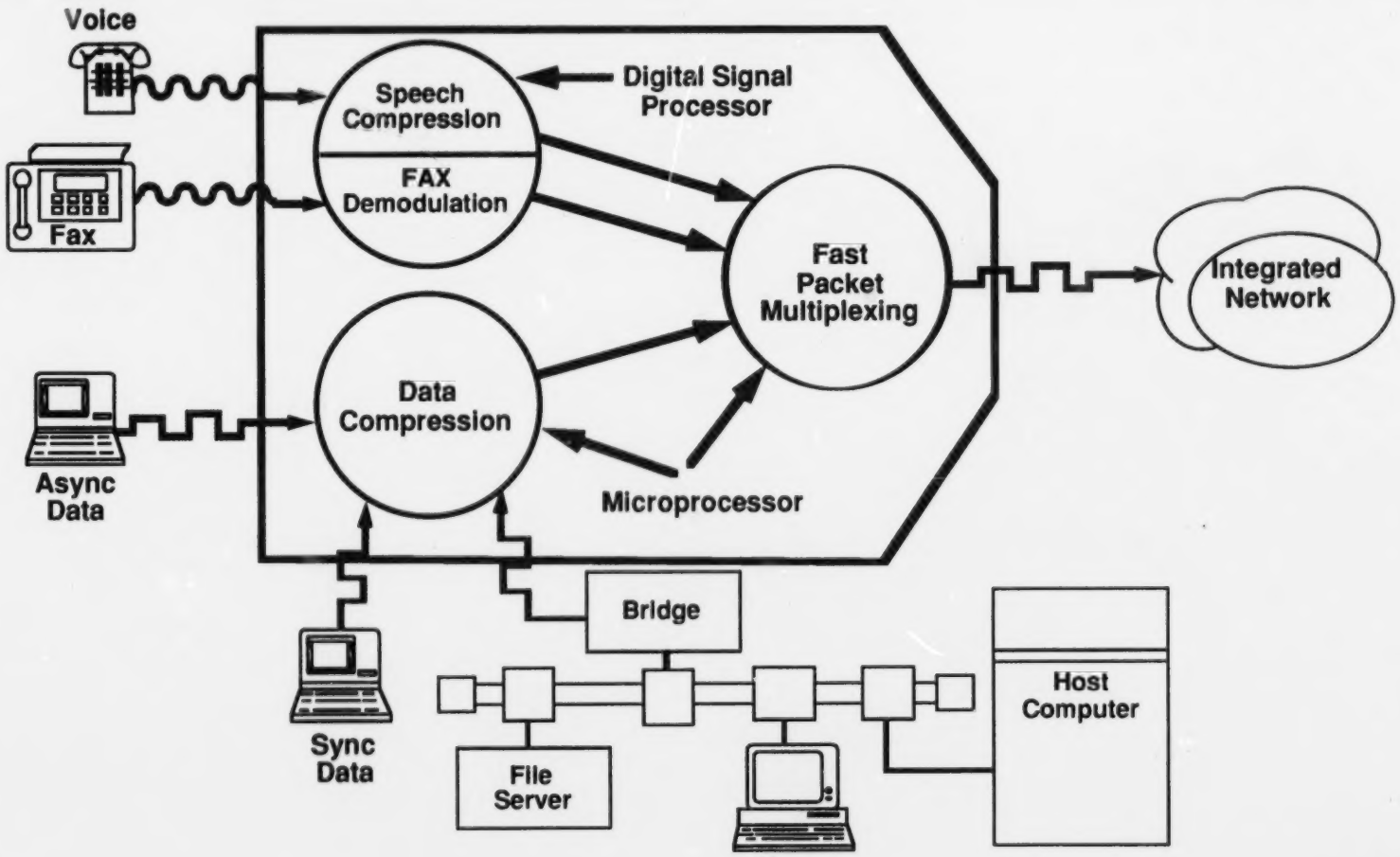
DATA/VOICE/FAX/LAN INTEGRATION FOR ALL



TECHNOLOGY DEVELOPMENTS THAT ARE CHANGING THE RULES

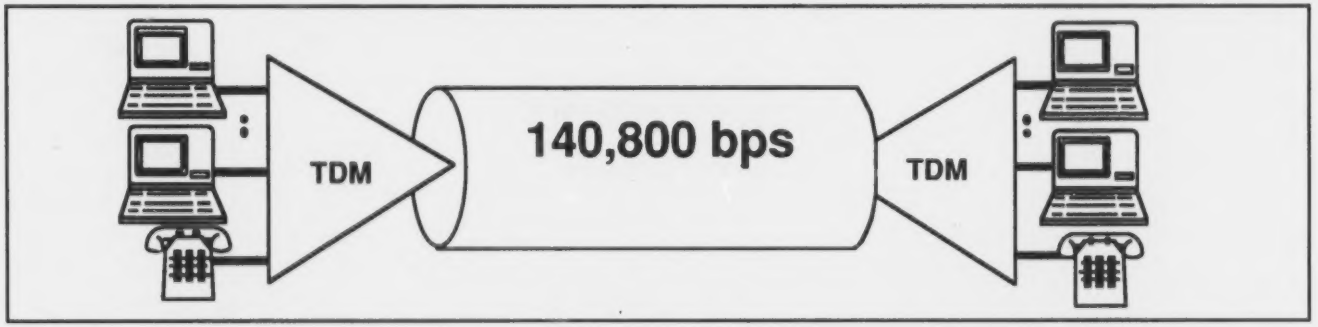
- **Four Bandwidth-Saving Technologies**
  - **Automatic Data Compression**
  - **Speech Compression**
  - **Automatic Fax Demodulation**
  - **Fast Packet Multiplexing**

TECHNOLOGY COMBINATION

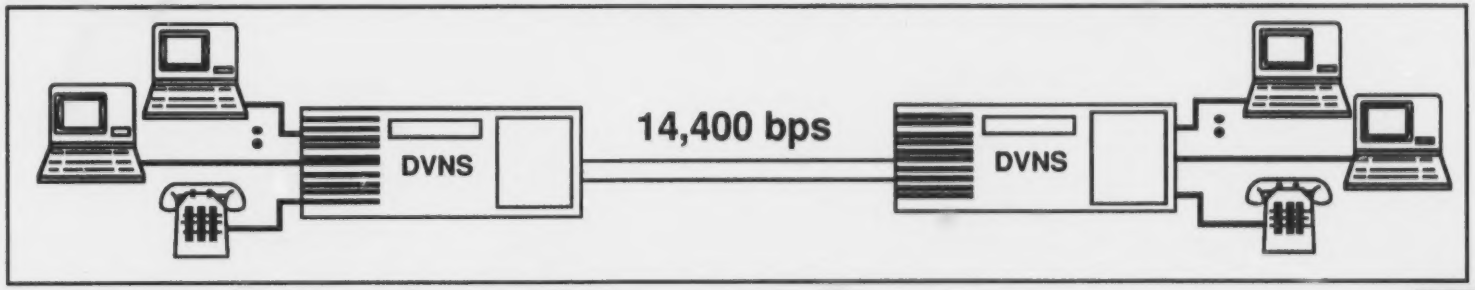


TECHNOLOGY IMPACT ON 9.6—19.2 Kbps LINES

- Example: 8 Terminals at 9600 bps
  1 Voice/Fax Connection at 64,000 bps
- With TDM Technology: Requires 140,800 bps

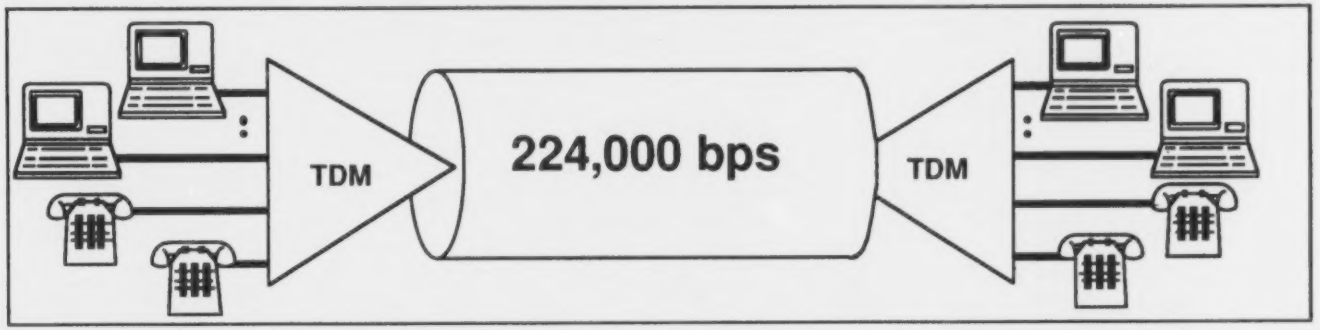


- With New Technology: Requires 14,400 bps

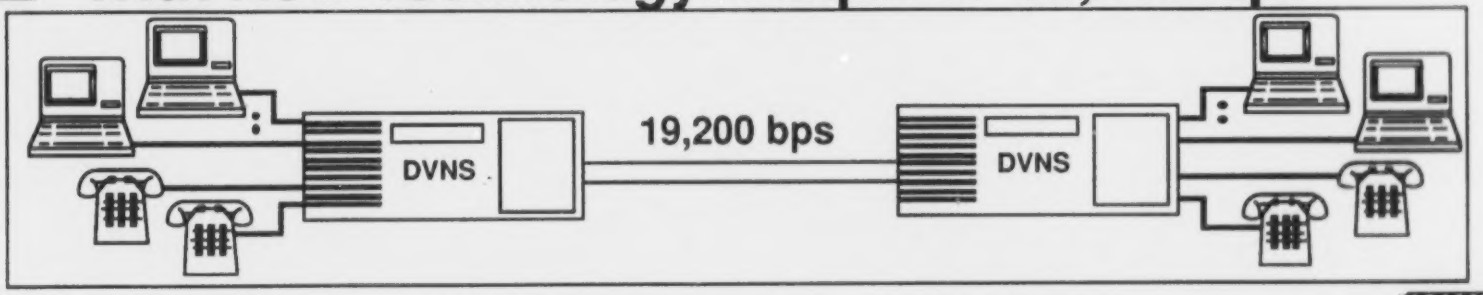


TECHNOLOGY IMPACT ON 9.6—19.2 Kbps LINES

- **Example: 10 Terminals at 9600 bps**
  2 Voice/Fax Connections at 64,000 bps
- **With TDM Technology: Requires 224,000 bps**

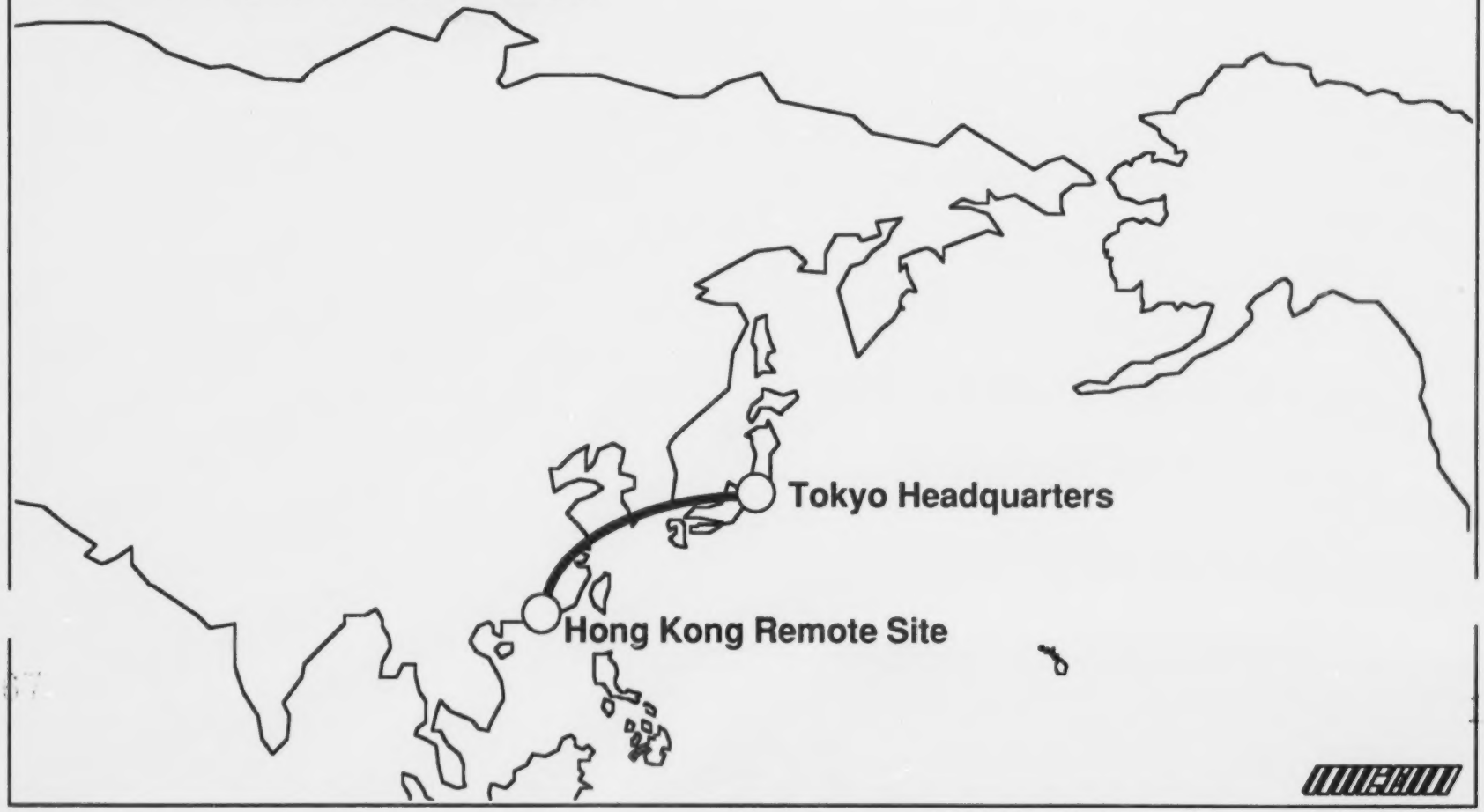


- **With New Technology: Requires 19,200 bps**

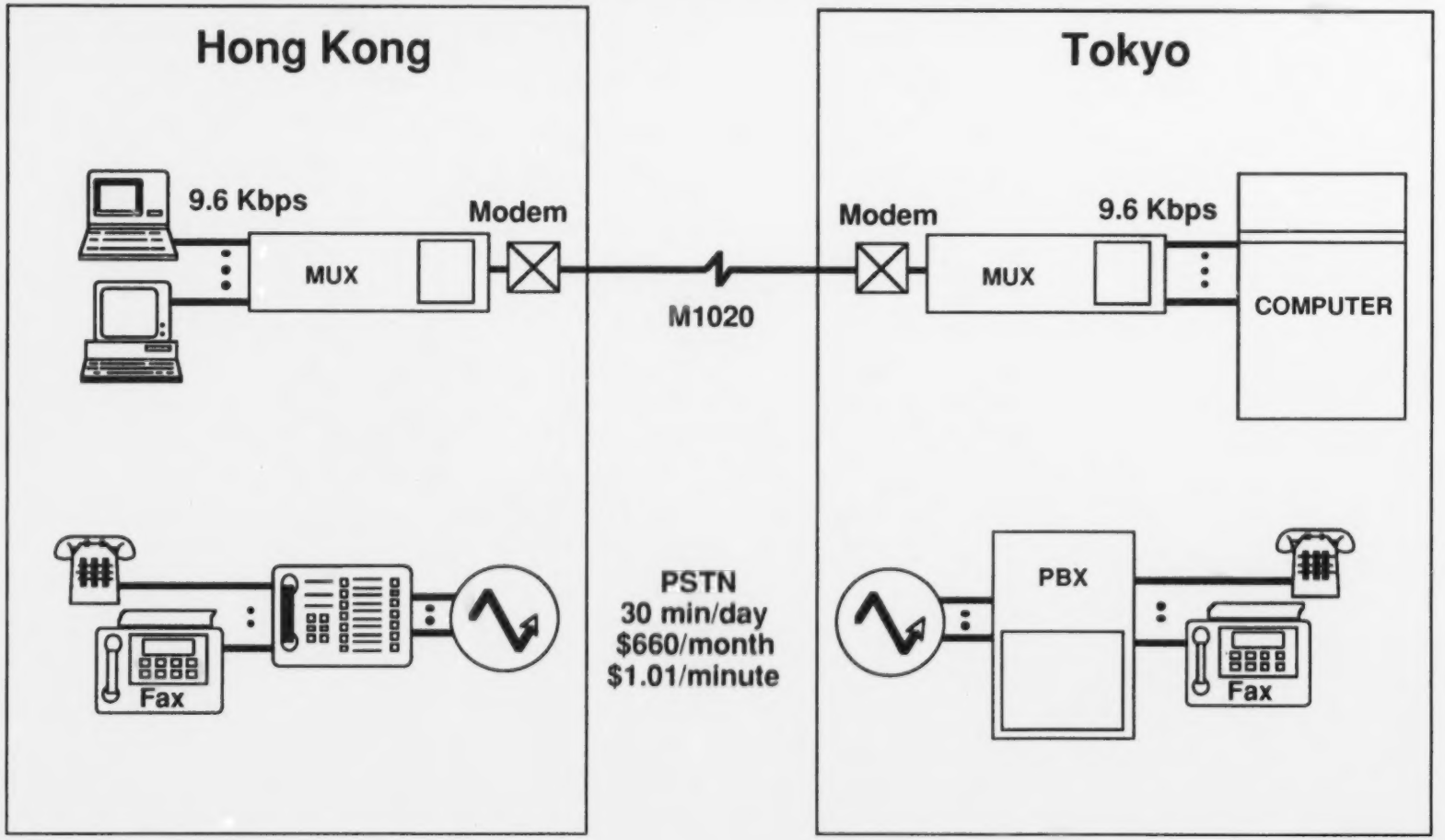


PAYBACK EXAMPLE USING AN M1020 LINE

- A New Installation



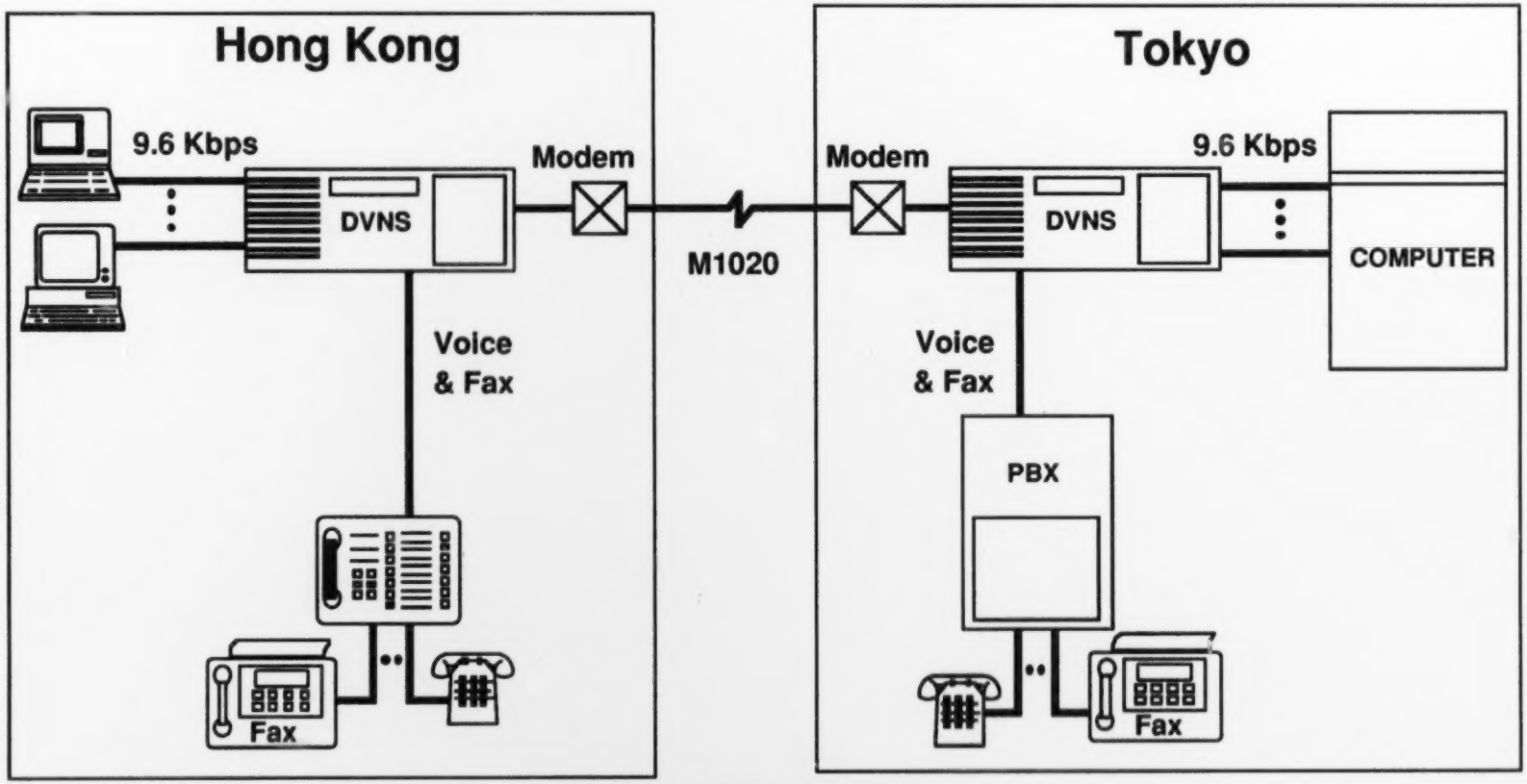
NEW INSTALLATION WITHOUT INTEGRATION



PAYBACK EXAMPLE TOKYO—HONG KONG

- Voice and Fax Toll Calls of 30 Minutes/Day
  - Toll rate is $1.01/minute
  - Monthly toll charges are $660/month
- Basic Data/Voice Network Servers Cost the Same as Data-Only Muxes
- Add-On DVNS Equipment:
  - 2 voice/fax modules cost = $2800
- Payback in 4 Months, Save $660/Month Thereafter
- DVNS Saves $8000 Each Year

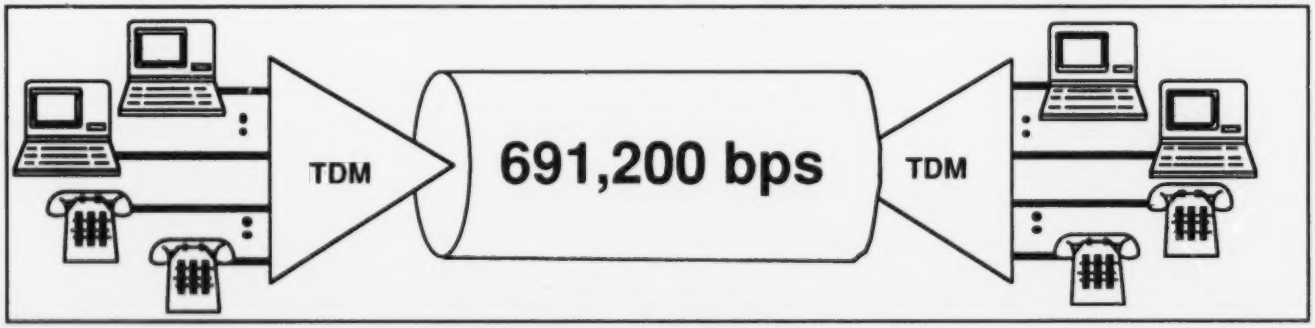
NEW INSTALLATION WITH INTEGRATION



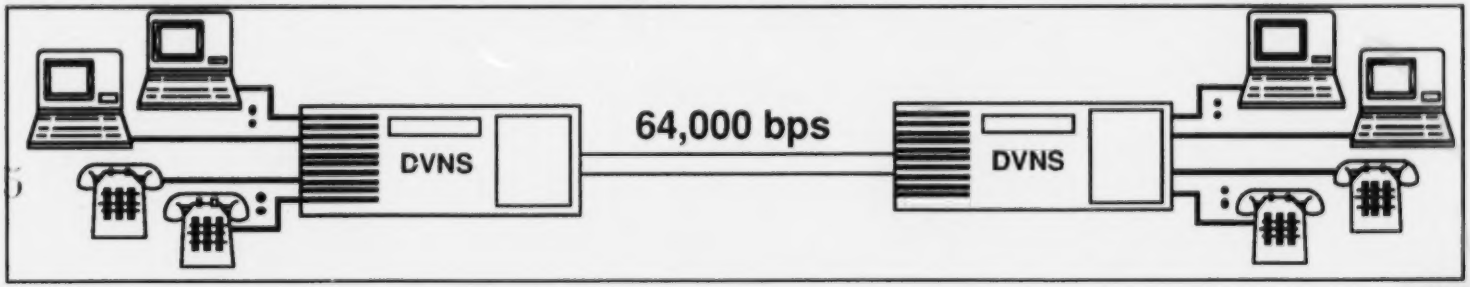
Save $660/month
4 month payback

TECHNOLOGY IMPACT ON 56/64 Kbps LINES

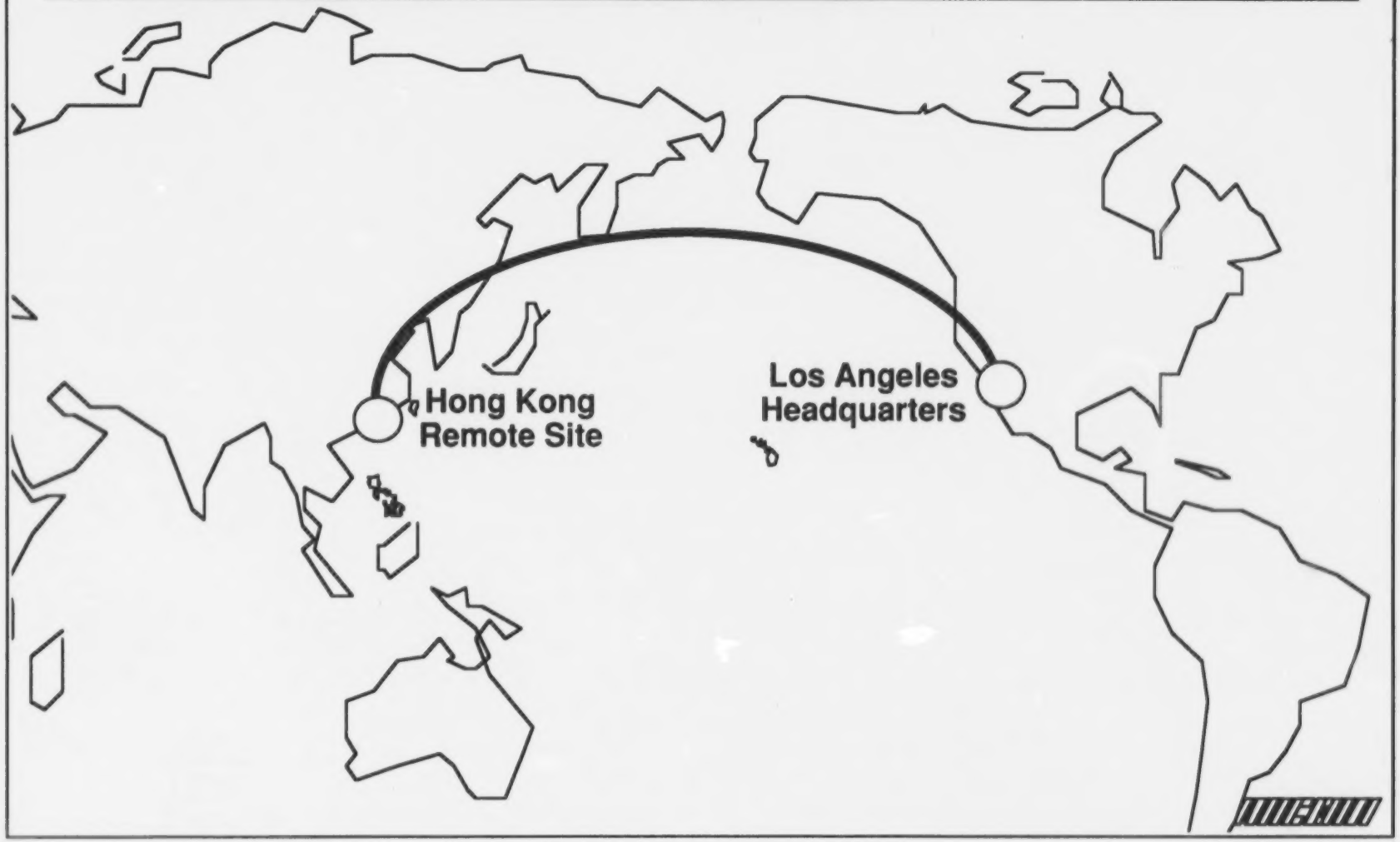
- **Example:** 32 Terminals at 9600 bps
  6 Voice/Fax Lines at 64,000 bps
- **With TDM Technology: Requires 691,200 bps**



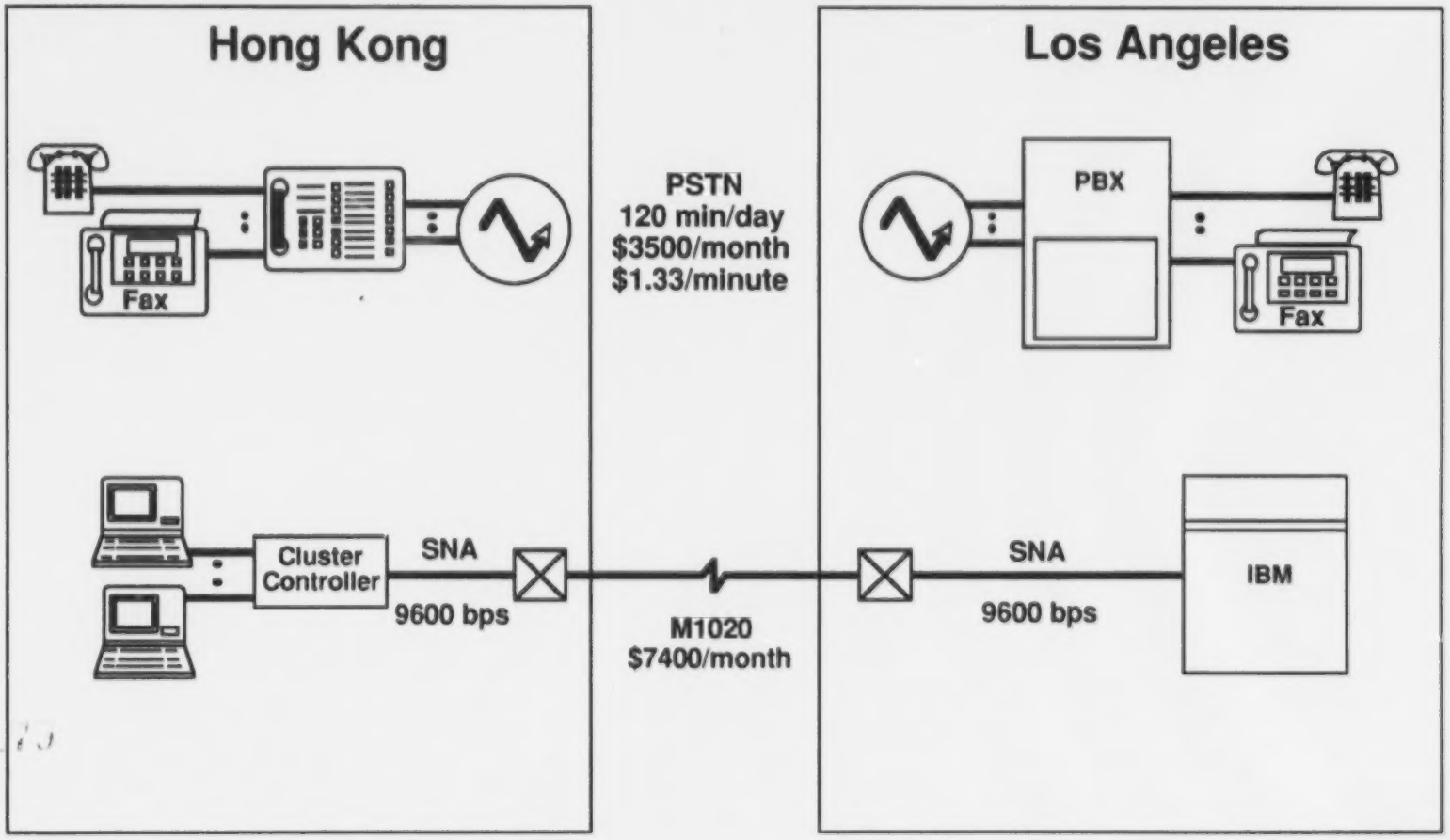
- **With New Technology: Requires 64,000 bps**



PAYBACK EXAMPLE AT 56/64 Kbps



BEFORE INTEGRATION



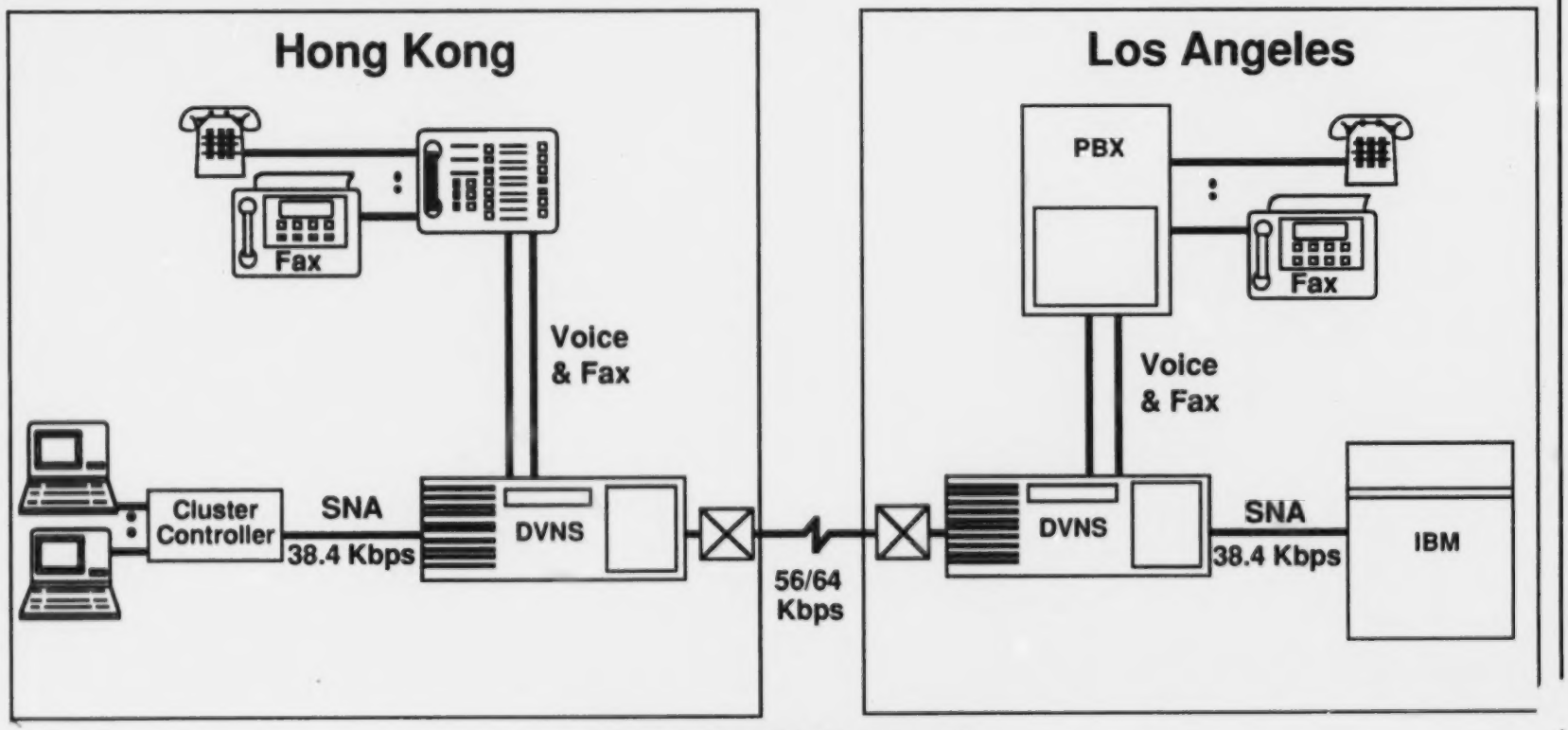
PAYBACK EXAMPLE LOS ANGELES—HONG KONG

- Voice and Fax Toll Calls of 120 Minutes/Day
  - Monthly toll charges are $3500/month
- M1020 Data Line Costs $7400/Month
- 56 Kbps Digital Line Costs $9100/Month
- DVNS Configuration:

2 Servers	$3,500
4 Voice/Fax Modules	4,400
2 Data Channels	INCL
Total DVNS Cost	$7,900

- Payback in 5 Months, Save $1,800/Month Thereafter
- DVNS Saves $22,000 Each Year

AFTER INTEGRATION



Save $1800/month
5 month payback
Data runs 4 times faster

DVNS IMPACT— THE RULES HAVE CHANGED

- Data/Voice/Fax/LAN Integration
  - For Small to Midsize Companies, Too
  - Low cost solutions using low speed lines
- New Technology
  - Speech and Data Compression
  - Automatic Fax Demodulation
  - Fast Packet Multiplexing
- New Bandwidth Plateau - 56/64 Kbps

TODAY'S PERCEPTIONS

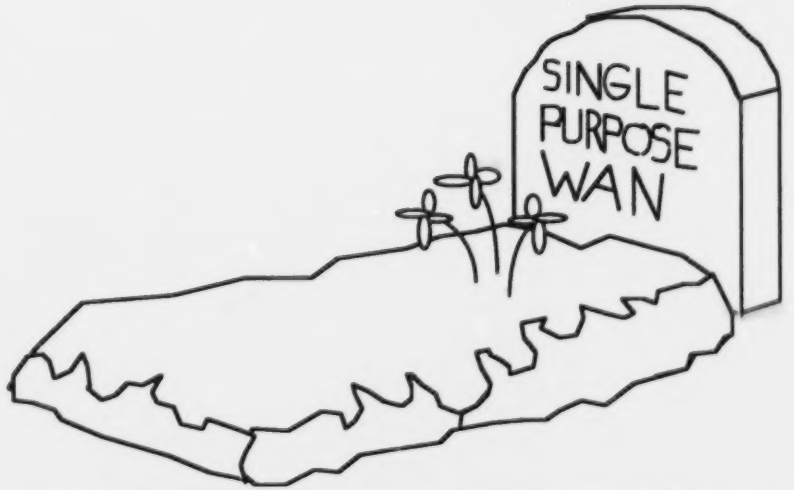
"You need to be a large company and use T1 to integrate data, voice, fax, and LAN"

"I didn't know you could integrate voice and data over the same low-speed leased line — especially to my smaller remote offices"

THE NEW REALITY

The Days of the Single Purpose Data-or Voice-Only WAN

are Over



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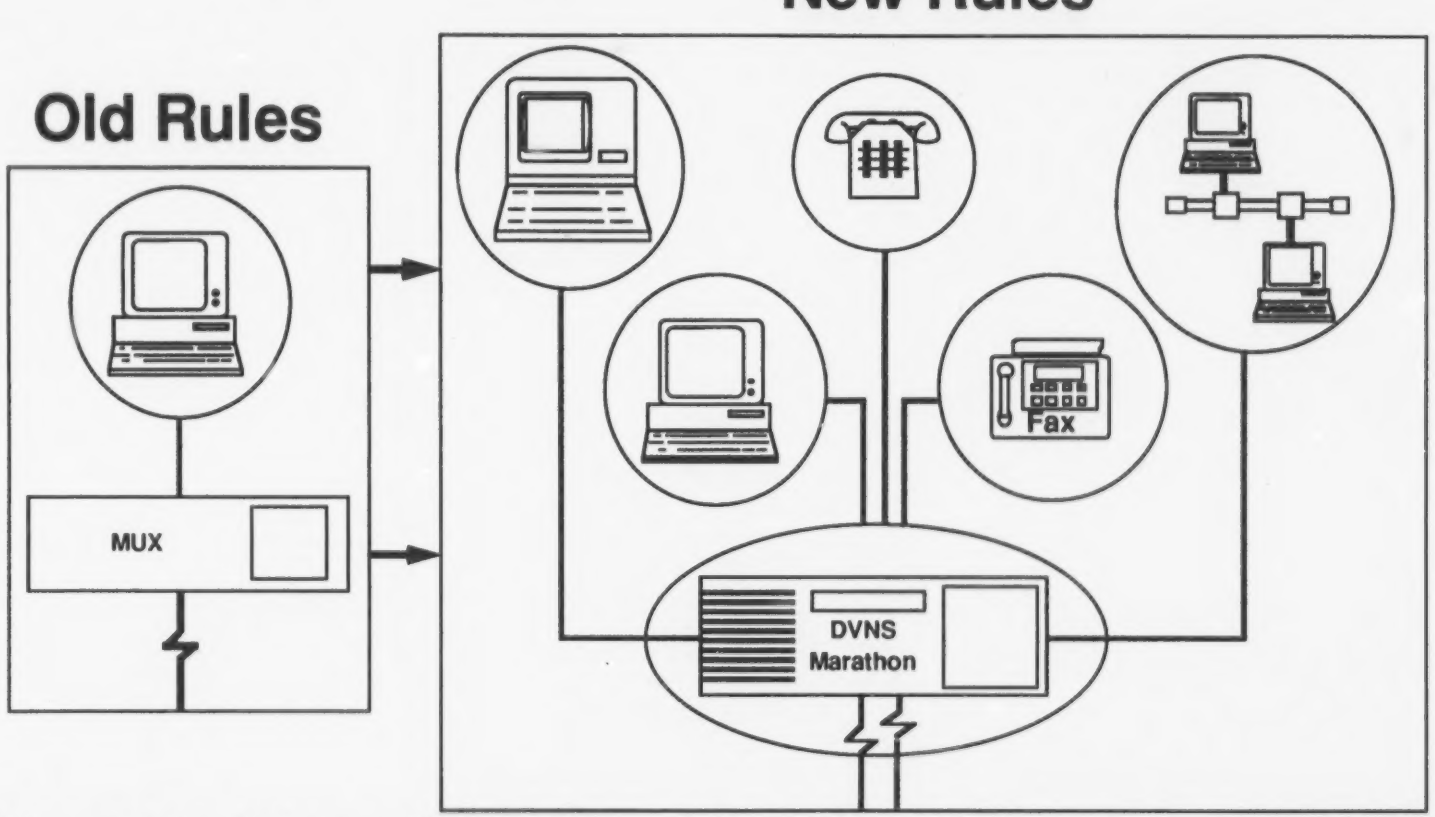
THE NEW RULES OF WIDE AREA NETWORKING



Affordable Integration of Remote Data, Voice, Fax and LAN

NEW INTELSAT EARTH STATION TYPE-APPROVAL PROCEDURES: LOWER COSTS AND SIMPLER IMPLEMENTATION

Calvin Harriott and Kenneth Dorvee
COMSAT World Systems
Washington, D.C.

ABSTRACT

COMSAT World Systems' (CWS') type-approval process is designed, primarily, to facilitate the rapid cost-effective entry of small earth stations into the INTELSAT global satellite system. The process ensures that any earth station, INTELSAT type-approved using CWS' procedures, accessing the system will meet the relevant INTELSAT standard and not endanger the integrity of system operations. For example, very small aperture terminal networks can be implemented on an international basis without the time-consuming and potentially costly process of detailed verification of each individual earth station in the network.

The CWS type approval process involves working with earth station manufacturers, vendors, or operators to determine the suitability of an earth station model for type approval. An earth station model is finally granted type approval after a series of design reviews, evaluation of manufacturing and quality control measures, specific functional and operational tests, and evaluation of test results. Purchasers and users of a type-approved model are subsequently allowed access to the INTELSAT satellite system without individual earth station verification testing.

Introduction

This paper presents an overview of the earth station type-approval process developed and implemented by COMSAT World Systems (CWS), the U.S. Signatory to INTELSAT. It also gives a brief analysis of the changes in the operating environment which provided the impetus for the type-approval process, including a summary of INTELSAT activities leading to its implementation. The U.S. Signatory's type-approval procedures are described, and their advantages, especially for small-diameter antennas, compared to the standard INTELSAT antenna verification and certification process, are presented.

Note that INTELSAT type approval cannot supplant requirements of administrations. For instance, in the United States, all earth stations must meet the requirements of Federal Communications Commission (FCC) Part 25 and be properly licensed.

Operating Environment Changes

Early satellite communications operation was defined by three basic characteristics: low-power satellite down-link transmission capability; analog FM transmission links, and large (up to 32 m), high-gain earth station antennas. In the INTELSAT system, these characteristics limited access to those entities that could provide the large "gateway" or multipurpose antenna systems. Today, however, there are many non-signatory users who own earth stations which are generally, though not exclusively, much smaller, simpler, and far less expensive than the original, or current, gateway designs.

Areas of concern for INTELSAT operation include interference to users of the INTELSAT space segment; interference to and from users of other satellite systems; excessive demand for transponder power caused by substandard antenna performance; and assurance that the earth station is capable of providing the required service quality. To preclude these problems, antenna owners/operators are required to demonstrate that new earth station antenna systems meet RF performance specifications. This is accomplished by conducting a series of defined antenna system verification tests to determine actual earth station performance in both transmit and receive operation. The complexity of the tests, and the antenna systems being tested, typically result in significant man-hour and resource expenditures for the earth station owner/operator, the signatory, and INTELSAT.

The typical cost in the United States for engineering support from an earth station vendor or integrator to an earth station operator to perform an INTELSAT on-site earth station verification is on the order of $10,000. This covers the cost of testing only; it does not include charges for necessary field adjustments or alignments if the earth station fails to meet the mandatory performance criteria.

If INTELSAT resources are used, the time normally required from receipt of an application to formal approval to

operate is approximately 13 weeks, assuming all goes well. Seldom does all go well.

Note that earth stations are approved in far less time if the required resources are readily available. A significant portion of the 13 weeks (8 weeks) is required to ensure availability of INTELSAT space segment and a communications system monitor (CSM). The U.S. Signatory competes with other signatories and INTELSAT operational requirements for the use of these resources, with INTELSAT operations taking precedence and signatories' requirements treated on a first-come first-served basis.

An owner/operator may make alternative arrangements such as using a domestic satellite (DOMSAT), which may reduce the time involved, but the basic cost of testing remains similar. In addition, costs such as those for the use of satellite transponders for testing (there is no charge for the use of INTELSAT space segment), the costs of transporting units to a test range, and the administrative costs of coordinating tests all add to the expense and time required to commission an earth station. However, in these situations the owner/operator has greater control over scheduling and performing tests than when using INTELSAT.

From the U.S. perspective, changes in the INTELSAT environment were driven by a number of technical, regulatory and operational factors.

Technical

Design and manufacturing advances in satellite and earth station technology have improved the performance of spacecraft, earth station antennas, and transmission techniques. Higher power satellite down-link capabilities, more efficient earth station antenna RF performance, improved receiver performance through the use of inexpensive gallium arsenide (GaAs) low-noise amplifiers (LNAs), and digital frequency-division multiple access (FDMA) techniques, made possible such new services as teleports close to urban centers, customer premises earth station (CPES) operation and Satellite News Gathering (SNG) using small earth station antennas down to 1.5 m in diameter. These options have made satellite communication an attractive and cost-competitive alternative to other communication media. The proliferation of earth stations means that their performance is even more a matter of concern for the overall administration of space segment operation and must be ensured. Also, finding ways to reduce the expense and difficulty of the required verification (of performance) testing on a per earth station basis becomes necessary.

The introduction of Ku-band transponders in INTELSAT satellites, through a new generation of hybrid satellites, enabled the operation of small Ku-band earth stations in urban areas. This is due to the more benign radio frequency interference (RFI) environment as compared to C-band. At the same time, this eliminated a major cost consideration, that of terrestrial access to C-band gateway type earth stations usually located in remote rural areas to escape terrestrial interference.

Regulatory

The regulatory changes that brought about the dissolution of the U.S. Earth Station Ownership Consortium (ESOC), which owned and operated the U.S. gateway earth stations operating in the INTELSAT network, opened the way for non-signatory ownership and operation of earth stations in the U.S. This trend is beginning to appear in other countries as well.

In April 1986, the FCC [1] facilitated the use of very small aperture terminal (VSAT) networks in the U.S. by liberalizing the licensing procedures for small earth station antennas operating in the 12/14-GHz frequency range. Concurrently, INTELSAT opened the door to type acceptance of earth station antennas but did not choose to mandate a process, leaving this responsibility to the various signatories.

Operational

Changes in INTELSAT's operational philosophy, the creation of new service classifications, and the development of tariffs for private-line services encouraged the growth of services such as International Business Service (IBS). Leased transponder services such as INTELNET (DATANET), television transmission and broadcast services, and the emergence of bandwidth-on-demand services such as short-term leases for special news events all became possible with the INTELSAT changes. This last category of service, bandwidth-on-demand, is still evolving.

All of the above factors lead to a relative explosion in the numbers and types of earth stations requiring access to the INTELSAT space segment. As shown in Figure 1, for the first 21 years of operation on the INTELSAT network the U.S. Signatory commissioned a total of 38 earth stations. In the last 6 years, applications for more than 360 earth stations have been processed by CWS. This number does not include receive-only (RO) terminals, as these obviously cannot cause interference to the space segment, although substandard sensitivity or gain-to-noise temperature ratio (G/T) could result in inferior performance or excessive demand on satellite down-link effective isotropically radiated power (e.i.r.p.).

Background

With the foregoing changes, the signatories' continuing responsibility to INTELSAT for operation of earth stations in their respective territories became significantly more demanding. Ensuring compliance with INTELSAT standards still depends primarily on performing verification tests for each individual earth station. In the era of few large gateway earth stations, this was not a major cost consideration. However, as the size and cost of earth stations were reduced, the cost of testing and certifying earth stations for operation on the INTELSAT system became a relatively significant percentage of individual earth station cost. Also, the time required to bring a new earth station into service became critical, given the competitive imperative for instant, or near instant, establishment of service links. Further,

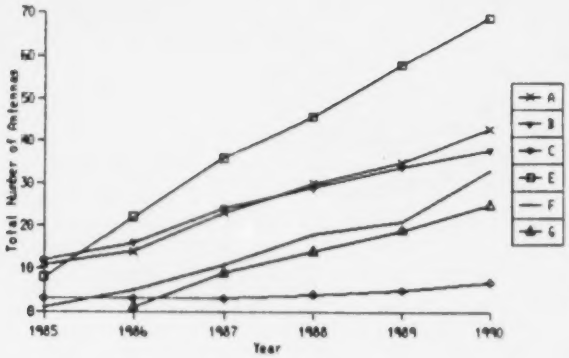


Figure 1. Cumulative Number of U.S. Earth Station Antennas by Standard for Each Year

the INTELSAT facilities which support earth station verification testing were stressed to the utmost by the volume of demand for their use.

Note that the provision exists for operation of an earth station in the INTELSAT system without the earth station having completed verification testing. However, this is used only in extraordinary circumstances and is granted for a limited period of time. A recent example of this was the provision of communication links to and from the Middle East during the Gulf crisis.

In response to this situation, two significant administrative actions led the U.S. Signatory to develop a type-approval procedure for earth stations accessing the INTELSAT system. In 1985, in a move to streamline the access process, the INTELSAT Executive Organ initiated a dialogue with the signatories regarding establishment of a type-approval policy for small-aperture antennas accessing the INTELSAT system. In April 1986, document OPSA 3-9-1 [2] was issued which addressed several aspects of the earth station approval process, including a general procedure for type acceptance of earth stations. The Executive Organ left the specific procedures to the individual signatories, but reserved the right to approve or disapprove earth station models proposed for type approval.

This started an iterative process among INTELSAT, the signatories, and various antenna system and earth station manufacturers and integrators which continues today. Using the type-approval procedure established by Inmarsat for ship terminals [3] as a guideline and in consultation with earth station antenna experts at COMSAT Laboratories, the U.S. Signatory drew up draft type-approval procedures designed to ensure the integrity of INTELSAT space segment operations while reducing the need to test every small aperture antenna, especially those used for VSAT or other multistation network applications. An important step in the evolution of the procedures was seeking out and incorporating input from U.S. antenna and earth station manufacturers. Other signatories such as Australia, France, Norway, Germany, Switzerland, and Colombia have used the same basic procedure to have antenna systems accepted by INTELSAT as meeting type-approval requirements. In a related step after discussions with U.S. VSAT manufacturers, the U.S. Signatory was able to obtain a relaxation in polarization discrimination requirements for a range of small earth stations.

U.S. Type-Approval Procedures

In theory, any earth station standard is a candidate for type approval. In practice, type-approval procedures [4] are directed mainly toward INTELSAT Standard D1, E-1, E-2, F-1, F-2, G, and Z earth stations. This is because practical aspects of antenna design tend to limit the reflector size and operating wavelength of antennas which can be fielded with confidence that on-site adjustment is not required. However, small antennas, which are the most suited to acceptance testing on a sample basis, are those most likely to be deployed in quantity and thus benefit the most from type approval.

Although early type-approval efforts emphasized antenna systems with a one-piece reflector design, antenna designs incorporating three or less segments have successfully completed the type-approval process. Antenna reflectors with multiple segments have been proposed, and one model with an eight-piece design is currently undergoing CWS type-approval testing.

To allow for maximum flexibility and to accommodate various entities such as antenna manufacturers, system integrators, and earth station operators, the U.S. Signatory's type-approval process has been implemented in a hierarchical arrangement. Currently, the procedures allow for the following three system combinations to be considered for type approval:

- The earth station model, which specifies the mechanical and electrical performance characteristics of all equipment and components making up a complete earth station system.
- The antenna system model, which specifies the mechanical and electrical performance characteristics of the antenna system, consisting of the antenna, mounting structure, and associated LNA.
- The antenna model, which specifies the mechanical and electrical performance characteristics of the reflector, subreflector, feed, mounting structure, and associated drive and pointing systems.

Each subsystem of a type-approved model is subject to performance analysis. Therefore, as more subsystems are included in the model the type-approval process encompasses more testing. Each manufacturer of a subsystem is required to fully participate in the type-approval process to ensure consistency, integrity of the manufacturing process, and quality control of their product.

The successful completion of a type-approval exercise is the result of close coordination and cooperation between the U. S. Signatory and the type-approval applicant. The sequence of events leading to the granting of type-approved status for an earth station model is as follows:

The Application - A statement of intent by the type approval applicant to the U.S. Signatory proposing a

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candidate antenna, antenna system, or earth station for type approval.

Phase I Testing—For this step, the applicant, under signatory guidance, develops and performs tests which demonstrate that the model meets applicable INTELSAT technical requirements. The tests are performed on a system which is identical to the production unit and are designed to verify the performance of the model to the maximum extent possible. They generally include subsystem tests and demonstration of their relationship to total system performance. However, it is acceptable to evaluate system performance to demonstrate subsystem behavior in cases where the subsystem performance cannot be measured directly. Also, the Phase I step demonstrates the margin of system performance above minimum requirements.

The applicant also identifies the operating environment of the model over which compliance with the standard is achieved. To the extent possible, the applicant provides the technical evidence which demonstrates these capabilities.

Once the Phase I test results have been analyzed and approved, the applicant and the U.S. Signatory jointly develop Design Review procedures and a Phase II test plan. This, again, is an iterative process that continues until both parties agree on the scope and general requirements of these steps.

The Design Review—Once the Phase I tests are completed and the results reviewed, the U. S. Signatory and applicant jointly participate in a design review. The process includes input from any subcontractors who provide subsystem equipment. The purpose of the design review is to demonstrate that the manufacturing process, quality control discipline, documentation, and assembly or installation procedures will result in a product consistently meeting the applicable *INTELSAT Earth Station Standards* (IESS) performance. This takes into account mass production and includes a review of field installation procedures to verify that proper performance will result without the need for on-site verification. Several iterations may be required before this step is satisfied. The output of this exercise is a Design Review Report, which is included in the technical documentation package for review and concurrence by the U. S. Signatory. This report, along with other technical documentation and accompanied by CWS' assessment of the candidate earth station's manufacturing and quality control, field installation procedures and system performance, a review of the process and procedures leading to this assessment and any special recommendations and comments, is formally submitted to INTELSAT following the successful conclusion of the entire type-approval process.

Phase II Testing—This phase is completed with the direct participation of the U.S. Signatory. The applicant performs functional tests of the model using an INTELSAT satellite, other space segment, or a test range. The method used is dependent on the earth station standard, the testing requirements, and the availability of resources and facilities. Range testing is the preferred alternative, as this provides the most flexibility in scheduling and performing tests. Normally, these tests follow conventional INTELSAT verification test procedures; additional tests may be added to evaluate added system options. Functional tests may also include "out-of-the-box" assembly or installation to demonstrate performance reliability in a simulated field environment. Several randomly selected production systems are tested to demonstrate performance. A single unit is disassembled and reassembled to verify repeatability and to compare performance with that obtained previously for this unit and for other units tested.

Following successful completion of the process, the applicant submits to the U.S. Signatory technical reports demonstrating full compliance with INTELSAT specifications. Following a thorough review, the U.S. Signatory certifies the system to the INTELSAT Executive Organ. It reviews the documentation supporting type approval and, if satisfied, assigns a type-approved designator. A type-approval certification listing the earth station standard(s) under which the model has been approved, a list of components or subsystems included as part of the approved system, and any restrictions applicable to this model are included with this approval. The approved model is added to the list of type approved earth station models in the INTELSAT network. This list is routinely provided to all INTELSAT signatories.

Modifications may be made to type-approved systems after consultation between the applicant and the U. S. Signatory, and discussion with INTELSAT. The modifications must be fully evaluated as to their effects on system performance, and any required re-testing of the modified system must be successfully completed. This process follows the general format of the initial type-approval process in scope, and the type-approval performance requirements must be met and demonstrated.

Follow-up testing of the type-approved model after certification can be requested by the INTELSAT Executive Organ any time deployed antennas appear to have degraded to the extent that there is evidence of resulting problems on the space segment. The U.S. Signatory also reserves the right to require follow-up tests to ensure the continued integrity of the manufacturing process and quality control.

COMSAT World Systems' Current Work With U.S. Vendors

Initial contact with U.S. vendors to introduce them to the type-approval concept started in 1986. Several meetings were convened to hone the process and to accommodate vendor concerns. However, following initial enthusiasm on the part of the vendors, there was a period of inactivity. Manufacturers and vendors were unfamiliar with, and possibly distrustful of, the process, and apparently had difficulty economically justifying the investment in cost and time required to obtain type approval in what they thought of as a limited market. At that time, U.S. earth stations in the INTELSAT network numbered less than 100, and the market was shared among a number of vendors. Therefore, the process remained at the discussion stage for a long time.

The first system was type approved by CWS less than 2 years ago. But since then, 12 systems built by U.S. manufac-

turers have successfully completed the process with the active involvement of three vendors and integrators. Interestingly enough, the first system was approved for use at an overseas location—Taiwan. Type-approval work is currently in process with a total of seven U.S. vendors and integrators.

Conclusion

Earth station type approval in the INTELSAT environment is still in its infancy. The U.S. Signatory believes this process is very important to the continued viability and growth of INTELSAT. Communications pundits predict that satellite communications will increasingly incorporate more and more VSAT type networks. This is likely, as communication niches of the future that capitalize on the strengths of satellite communications may depend heavily on VSAT communication links, and CWS is endeavoring to stimulate growth of such networks. Earth station type approval will be a significant factor, making implementation of such networks possible in a timely and cost-effective manner.

The type-approval process has started and CWS hopes that this will encourage other manufacturers and vendors to get involved, if only to protect their market share. The net result will ultimately benefit service providers and end-users through lower costs and faster network implementation. It will also reduce administrative and operational costs to the U.S. Signatory and INTELSAT. The decision to implement earth station type approval may very well be one of the most significant decisions in INTELSAT's history.

Acknowledgments

The authors would like to acknowledge the assistance of Calvin Cotner, Director of Technical Liaison and Analysis, CWS, who was instrumental in getting the process off the ground and providing insight into the development of this paper; to Dr. Ernest Ekelman of the Earth Station Antenna Department, COMSAT Laboratories, whose expertise was invaluable in making the process work, and U.S. manufacturers for their continuing support of the development of INTELSAT type approval.

The authors would also like to thank Betty C. Alewine, President, CWS, Carl M. Jeffcoat, Vice President, Operations and Engineering, CWS, and Richard Skroban, Director, Earth Station Services, CWS, for their encouragement and support.

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From Experience:

Where Does Your Technology Fit into the Marketplace?

by

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and

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Introduction

Introduction

More and more, today's companies are trying to capitalize on technology to gain sustainable competitive advantage. They realize that, as the rate of technological change increases, their products and services must be more advanced, faster, better and easier to use than their competitors' products and services. However, the question with which companies are often faced centers around how to convert their new products or technologies into business opportunities. They need a process to assess where the technology fits in the marketplace, to size the market, to see how fast the market will evolve and to come up with the most effective market penetration strategy.

New technologies emerge from a number of places. Sometimes they are the result of a tightly focused R&D effort to find a solution to a specific set of customer needs. However, in a surprising number of instances, new technologies emerge as an unexpected by-product of R&D efforts. These are not directed at solving a specific set of marketplace needs; rather, they appear to have a potential fit into markets and applications that are outside of the company's scope of business. Every large R&D laboratory has its list of unexploited technologies because technologists are rarely able to translate technology into business opportunities. This is true for several reasons:

- New technologies are rarely one-for-one replacements of existing technologies; they usually cut diagonally across more than one application
- Most technologists look to applications that optimize the technology. Often, the best marketplace fit is not the best technology fit
- Technologists want to put their technology into the largest market opportunity. Frequently, the best place to insert the technology is in niched market applications where end users place high economic value on the technology

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Technology Screen

Technology Screen

A process called the Technology Screen is particularly valuable for companies that want to assess where a new technology fits into the marketplace. This is especially true in both of the following situations:

- When a product or technology has been developed and a company must identify its market—end-user groups possessing needs that the product or concept can satisfy at an acceptable cost
- When a product or concept has entered R&D but is not yet fully defined and the company must clearly understand the needs of target end-user segments in order to effectively continue development and launch of the product

The key variables that must be considered in both of these situations are buyer needs (segment prospective buyers based on the product features and benefits they require), economics (use a value analysis to determine the buying segments for which it makes economic sense to adopt the new product or technology) and time (determine the most realistic adoption timetable for buying segments and gauge both near- and long-term market opportunity).

Each of these variables should function as a screen to allow companies to further define their product launch strategies by answering questions such as: How big is my market? Where is my market? When will my market develop? How do I reach my market?

Screening the market is an iterative process. A non-linear approach is especially valuable in the environment of ambiguity in which new product teams work. It allows them to learn as they go, sort out what is and is not important and adapt their approach during the process. Each screen may be applied and reapplied as the product or technology is modified and redefined. The universe of

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- what broad performance requirements does each application segment have?
- how do those requirements relate to system configuration and functionality?
- what is the variance in requirements across the application segments?

- Which channels should Proxim pursue in developing partner relationships?

The company's team of management, strategic marketing, engineering and finance specialists believed they had a differentiated product. However, they were unsure of the best markets and opportunities to target and pursue with the product. They needed market-based information to develop the optimal go-to-market strategy.

The first decision Proxim's team needed to make was where to place the initial focus. Given a broad capability, it would have been very costly for Proxim to evaluate the total universe of product options and market segments. An initial series of brainstorming sessions was used to develop a straw man for Proxim's radio-based, micro-programmable controller called the NanoController. Next, the group generated several hypotheses concerning where NanoController applications might exist.

A series of discovery interviews were conducted with experts, end users and vendors of competitive technologies to validate the hypotheses. As a result of the screening process, 18 application candidates were identified, which were further condensed into five application families, each with a set of distinctive characteristics on the functionality of the NanoController in the application, the type of solution offered and the benefit sought. Each screen—Needs, Economics and Time—revealed crucial information for Proxim's team.

Needs Screen

- Potential end users' business characteristics

Market information on these issues will point cross-functional teams to the major benefits or capabilities of the product or technology and those end-user groups with the greatest and the least need for each. This information can be plotted on a matrix to indicate those segments where the product or technology is or is not a fit. In analyzing the matrix, teams develop hypotheses by asking questions of themselves, such as: What common business characteristics within this group make them a fit, and what common characteristics exist within the low-probability group? Eventually, discussions will point to some segmentation hypotheses.

These hypotheses are confirmed by opening the interviewing process to include a larger portion of the universe within these perceived segments. Screened end users are then plotted on the matrix, confirming or denying previous segmentation hypotheses.

Interviews are conducted with those individuals who fall into the low/low-probability quadrant to determine what it would take to move them into the high/high-probability quadrant. The information helps teams begin to chart a migration strategy and possible timing of near- and long-term market opportunity.

The Needs Screen often tells companies along the way that the functional parameters—what the product does—must be redefined and tested again with buyers. At the same time, it helps them determine if what the product does not do is a major obstacle.

After completing the Needs Screen, companies can also determine how to communicate with buyers about the product in ways the buyers will find meaningful. For instance, Proxim learned through interviews conducted with experts, end users and possible competitors in the

Economics Screen

Economics Screen

The Economics Screen examines only those prospective buying segments that the Needs Screen has identified as potential fits for the new product or technology. The next step is a value analysis to find out if the product or technology makes economic sense for these buyers. This is accomplished through additional interviews that entail asking the market how it cost-justifies the new product or technology.

The Economics Screen reveals economic issues by asking prospective end users questions that help determine:

- How the need is being addressed today, and at what cost
- What will happen to the cost of today's solution over time, and why
- What the cost of adopting and using the new technology or product will be
- What other "value" it will bring to the prospective buyer, and what form this value will take
- If the new product or technology is economically advantageous for the prospective buying segment to adopt now or in the future
- If there are any other technologies that impact the application and economics of this new technology
- How the market defines the competition

Once the market reveals these keys to cost-justification, teams can define those segments for which the product or technology is the cost-effective, optimal solution. They can ask additional questions to gain a sense of adoption timing for each segment, an indication of how the product fares versus the competition's and how and why the product would be accessed. Possible questions include:

Time Screen

Time Screen

The Time Screen looks at those buying segments that have passed through the Needs and Economics Screens because they are likely to adopt the new product or technology. The first two screens have confirmed that there is a business opportunity and enough economic value for the market to develop. The Time Screen defines the rollout timetable for the new product or technology for each previously identified segment as it helps answer through additional interviews:

- Is the buyer actively trying to solve a problem that the product or technology can address?
- What organizational changes would have to take place in order to make adoption possible?
- Based on the answers to the first two questions, how long will it be before the prospective segment begins to adopt? How quickly will the segment be penetrated by the new product/technology?

The Time Screen research process allows teams to plot segments along a problem-solving continuum, which includes those actively trying to solve the problem that the product or technology addresses (action), those shopping for solutions (cognizance) and those who may have a problem but do not recognize this fact (precognizance).

After plotting the segments along this continuum, teams can then develop, test and confirm hypotheses related to:

- The barriers between each continuum phase
- The percentage of each segment that falls within each phase
- What it will take for each group to pass through the barriers and move along the continuum

The Time Screen helps determine how fast the market will develop, how long it will take for elements of the product

How to Use This Tool

How to Use This Tool

The screening process should be used to define new products or technologies and the most effective launch strategies. Companies should build on this analysis to develop strategies that:

- Assess the viability of the new products or technologies by buying segment and identify short- and long-term applications and opportunities
- Identify the near-term market and estimate the migration of market growth
- Establish benchmarks that must be met for estimated growth to occur
- Identify priority market segments and reveal buying behavior
- Define specific activities and support required for each segment during the buying process
- Provide a model for resource allocation to the new product or technology launch
- Profile target buying segments' key characteristics and offer a screening methodology to continue to identify these high-probability buyers
- Identify other potential new product or technology opportunities based on unmet needs of buying segments
- Create a data trail that can be used to adapt the product or accelerate adoption

Clearly, if companies are to use technology as an advantage, they must adopt a sophisticated marketplace discovery process. As in Proxim's case, marketers and planners should take an active role in organizing a team to look critically at the problems and opportunities inherent in new products or technologies. Involving a number of key players is crucial, as the implications of new product development cut across many functional areas without

About
Frank Lynn & Associates, Inc.

About Frank Lynn & Associates, Inc.

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BRINGING PRODUCT TO MARKET

Brian G. Holton
KTSF-TV, San Francisco, USA

Good afternoon. It is great to be here and I'm honored to be with such a distinguished panel. I also wish to thank Michael Berg for being our moderator today, and I wish to thank all of you for being here today as well.

Today, I wish to focus my talks on how our company brings television programs from the Far East to the San Francisco market, and how we wish to send programs to overseas markets and the types of problems we encounter doing this. I wish to share with you what our television station sees for the future, considering all the current and evolving technologies and inform you that KTSF and others like her are currently a vital link in the communications food chain. Ultimately, I hope to shed some light on how we can work together to distinguish and identify the best alternatives for the transportation of video products overseas so our company can bring the product to market.

As I said, KTSF is part of the communications food chain as you are. You are able to provide transportation vehicles for the transmission of information over great distances and in great volume, via satellites, fiber optics, Teleco, etc. We, in turn, select the types of information needed for our market and deliver this product to the home, via our television station in the San Francisco Bay Area. We then solicit advertising support to pay you for your services and, in the end, Mr. and Mrs. Wong (the end-user) purchases the advertisers' product. For our company, this conference offers the opportunity of exploring and finding the most efficient way to bring the product to market so our advertisers can advertise affordably; Mr. and Mrs Wong can afford to buy the advertisers' product; I can pay you and make a modest profit.

As Michael informed you, I work at an independent television station in the San Francisco Bay Area. KTSF is not affiliated with any other television stations in the United States and we are owned by the Lincoln Broadcasting Company, a California Limited Partnership. We are a family-owned television station and our programming focus is televising overseas programming to the culturally diverse communities of San Francisco and Northern California.

We broadcast twelve different languages weekly and our main emphasis is the Asian Market. We broadcast in Chinese (Cantonese and Mandarin), Japanese, Korean, Tagalog, Vietnamese, Greek, Italian, Farsi and several others. Our programming runs the gamit from variety and movies to dramas and news, with news playing the most vital role. In many cases, we gather information in bits and pieces from around the world, and we package and produce programs for our television market and, in some cases, we syndicate the properties we produce worldwide.

News and information from overseas is the single most important aspect of our programming line-up. It so important we began the first live Chinese newscast in the United States in 1989 and by all accounts, this program has been a smashing success in San Francisco and Northern California.

In the San Francisco Bay Area, Asians comprise nearly 17% of the market and most are recent immigrants. Therefore, much of our business deals with Far East nations and KTSF is the primary source of news and information for many of these Asians in the Bay Area.

KTSF also produces and broadcasts several specials such as the Chinese New Year's Parade, The Miss Asia of America Beauty Pageant, The Chinese Martial Arts Championships and Masters Exhibition, and several others. We broadcast and syndicate these programs worldwide. In the case of the Chinese New Year's Parade, which is the largest nighttime parade in the world, and one of the largest celebrations of the Lunar New Year outside of Mainland China, it is a spectacular event and we produce and broadcast this property in two languages simultaneously. From a visual standpoint, this program is exceptionally delightful with all of its color, pageantry and tradition, and, although I cannot speak any of the languages we broadcast, I certainly enjoy the pictures.

In the case of the Chinese Martial Arts Championships and Masters Exhibition, we produced the property in three languages: English, Cantonese and Mandarin and in 1990, we syndicated the property in English nationwide on Prime Network, a cable sports network reaching nearly 19 million homes in the United States.

Currently, we employ several modes of transport to acquire and send programming to and from overseas. These include the use of domestic and international satellites, airliners, faxes, telephones, UPS, Federal Express, microwaves and human messengers. In fact, we would even use the Pony Express or Morse Code if we thought we could send or receive the information we had to in an economical and expedient manner. Our selection of transport vehicles is based upon three primary needs: costs, speed and dependably.

For example, with News we need to be concerned with the timeliness of a story, but at the same time, we must consider the costs. If a story has significance, we might pay the tremendous costs of Intelsat, but if we are purchasing movies and dramas, perhaps we would receive by Pony Express. For the specials we produce which go live, we employ a redundant set of microwaves, Teleco, domestic uplinks and our own terrestrial delivery system to bring the product to market.

At this time, I would like to give you a couple of examples of projects we currently have underway and future projects we are reviewing.

For our Chinese Newscast, news sources comprise nearly 25% of our budget of which the transportation costs, not the license fees, make up a significant portion of these cost. I want you to understand the problems I face as a broadcaster doing business between the United States and the Pacific Rim and may be you will be able to help me bring my product to market in a timely, dependable and cost-effective manner.

Currently, to receive our news sources, we use faxes from overseas reporters, live phone interviews, subscribe to several news entities such as UPI, Bay City News and CNN, and we acquire video footage from Hong Kong, Taiwan and Mainland China. From Hong Kong, we receive the footage via air freight and it is about two days old by the time we go to broadcast and the video reports from Mainland China are sometimes as much as two weeks old. From Taiwan, we receive same day news via international satellite. Of our three daily Japanese newscasts, two are received via international satellite and one by airplane. Our Korean and Italian Newscasts are received daily via international and domestic satellites.

Right now, we are working on a couple of projects where the cost and timeliness of delivery is one of the major obstacles. For example, we have a newscast from the Philippines we are attempting to acquire, but the costs for international satellite time, uplinks and downlinks are cost-prohibitive. We will probably run on a one or two day delay employing the airlines, however, during the Philippine elections scheduled for May this year, we will attempt to go live.

We are also working on a program with our sister station in Taipei and will need to establish several communication networks for video and voice. This program is a co-venture between the stations and involves time critical video reports from several nations around the Pacific Rim which will need to be edited together rather quickly to be ready for timely broadcast.

The problems we face in attempting to get or send information overseas is the cost and the cumbersome logistics. For example, for international satellite feeds, we need to get matching orders, one from our side and one from their side to get the satellite time. If you ever tried to explain to your overseas counterpart at 2:00 a.m. Pacific Standard Time what a matching order is in foreign language, you can just about forget the timeliness of that news report. I keep thinking the process must be simple and I just need to study a bit more but I have yet to find the process of arranging international uplinks, transponder time and downlinks easy. This arrangement problem is then exacerbated when I then need to take the international feeds and transport them to our station. Problem number one hits when on the West Coast in my area, there are only two international downlink receive sites. This requires us to arrange microwaves hops to our station, or, in some cases, we actually send messengers by car to pick up tapes. The second problem occurs when we find out these international receive sites can only record NTSC formats. One time we had to

borrow a converter, drive two hundred miles to the receive site, install the converter, and instruct the personnel how to convert from PAL to NTSC. This particular example demonstrates an irony in the speed of communications today. We could send a signal thousands of miles in seconds, yet it took about six hours to transport this signal just 200 miles! In essence, if I am going to employ this new technology, we need to find a way to make the process simpler.

The overall speed of international communications plays a large role in our ability to get information to market quickly. You know in 1903 then President Theodore Roosevelt sent a cable around the world and it came back in twelve minutes, today one would think that is ancient history, but in my case above, that was quick.

My point is, the development and use of all this high technology sometimes misses it mark because it does not consider or cannot deal with the total communications food chain. As you know, today there are many businesses and people involved in the transportation and interpretation of information, and one must attempt to look at the real problems facing those who underscore and bring the product to market. I call it marketing. Is marketing sales? I don't not think so. I look at marketing at how I can solve my customers' problems, not what I can sell them. In order to understand my customers problems, I need to study what it takes him to do his job, I need to be very familiar with his business, I need to walk in his shoes to understand his needs, in essence, if I ran his business would I buy my services? Example: We worked for a long time attempting to get a small retail account and we tried to talk with him many times but he was always busy, on the telephone, running the store, etc. When we finally got a meeting with him, he informed us he was trying to hire someone to assist him, but he just did not have the time to interview people and he was afraid to hire just anyone since he'd had bad luck in the past. The first thing we did was write him a job description for the position, posted the position through our referral system and had our Personnel Director discuss with him what questions to ask when hiring. He hired someone in about one month and we got the account.

As I stated before, transportation of information in an economical, dependable and timely manner has not only changed our world but has become a necessity for survival, and will become common place, like a telephone. History tells us that wars have been won and lost and governments have risen and fallen because of the timely transportation of information and to whom this information was provided. The Gulf War was won not only because of military might but in great part, won due to surveillance and the transportation of this information to the generals in the theater of operations. The events of Tiananmen Square in 1989 and the recent breakup of the Soviet Union were due in great part to the dissemination of information.

My job is to determine what is needed and desired by my market; my market happens to be the Pacific Rim. We create and use products from overseas and send the same. Our job is to bring the product to market in the most cost-effective and efficient manner so that the end user/consumer of the information can afford the same.

Our company is a user of your technology and there are many more like KTSF. I suggest that the days of only large players in the international information delivery business such as AT&T governments and the military are lessening. Today, there are three international type networks in the United States, many non-secular programmers wish to go overseas from the United States, there are at least four televisions stations on the West Coast who are in the international program business and two more which are seriously considering going international, and, of course, many today are concentrating on the European market for video distribution.

As you know, we are approaching a globable village, or as Walt Disney said, "It's a small world after all." Transportation of information is changing our world. When someone thinks of San Francisco they think of the Golden Gate Bridge and Chinatown. But if you look at it from a little different perspective, you can the Golden Gate bridge analogous to Ellis Island and Chinatown not as a town but as a city. These new Americans have families overseas and wish to know what's happening in their homeland, and families overseas wish to see and hear their loved ones in the United States, (example, Taiwan for talk). People today and of tomorrow will have more choice as where to live or visit, and consequently, the miles separating family and culture will be mitigated by the speed and efficiency of communications, however, the cost, dependability and logistics need to get better.

With possible Teleco entry into the distribution of products, compression, DBS, and the multiplexing of Cable TV, new players will enter the arena of distributing the product to the market. Some television stations fear these new technologies such as DBS and compression, and although they will change the way we do business, KTSF Television sees some opportunities for growth.

We believe the free-unencumbered development and use of technology will allow for greater competition and, thus, enable the consumer or end user of the product to prosper which is necessary fuel for the communications food chain. We plan to take advantage of opportunities presented in this conference to enhance our companies' commitment to serving the diverse culture of the San Francisco Bay Area and Northern California and if God willing, produce a modest profit.

I thank you for your time and I hope that we will work together to bring the product to market efficiently, dependably and economically.

Thank you.

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ECONOMIC AND TECHNICAL CONSIDERATIONS OF A GSO GLOBAL MSS (TRITIUM)

Pacific Telecommunications Conference
January 12-15, 1992
Honolulu, Hawaii

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Summary

This paper reviews a study of an advanced geosynchronous orbit (GSO) mobile satellite system (Tritium), which offers an alternative to the recently advocated low earth orbit (LEO) operational proposals. The study illustrates that the improvements featured by LEO mobile satellite system (MSS) configurations can be better provided by GSO communication relays and at a substantially lower cost. In fact, on a per-channel basis, geosynchronous systems offer similar service that is an order of magnitude less expensive than low earth orbit alternatives. The issue of hop delay is not a significant factor when assessing market demand since the majority of potential users will have, at best, limited access to substitutes. The inherent flexibility of GSO systems provides a unique ability to adjust to evolving market demographics. These factors allow geosynchronous MSS to offer the most affordable service that satisfies the public demand.

Furthermore, the study concludes that advanced GSO MSS capabilities can be implemented with more conventional technology, which offers longer life and less operational complexity. These GSO system service features not only offer equivalent performance and substantially improved reliability, but also provide compatibility with equivalent low cost mobile terminals proposed for LEO's with the same global connectivity. Most important, the advanced GSO system features improved spectral efficiency over currently operational MSS configurations and over some of the new LEO contenders.

Introduction

The Tritium mobile satellite concept is a geosynchronous approach to providing global cellular radio communication. It features mobile-to-mobile user and mobile-to-fixed user communication. Tritium achieves global coverage by three GSO satellites, separated 120° in orbit; each satellite covers its part of the earth with up to 160 beams. The inbeam and interbeam connectivity is provided by Ku-band backhaul links and by earth based switching. The power spectral flux densities at the earth's surface produced by the Tritium satellite beams will not exceed the maximum values set forth by the Radio Regulations. The maximum capacity per satellite is 30,000 links and the total Tritium system capacity is about 90,000 duplex circuits. This capacity is placed where it is needed, namely over populated areas, whereas over 80% of the advertised total Iridium capacity of 285,000 circuits is placed over largely unpopulated areas or is unusable. Therefore, the three satellites of the GSO Tritium system have nearly 50% more effective capacity as the 77 satellites of the Iridium LEO MSS.

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System Economics

In an effort to compare the relative strengths and weaknesses of low earth orbit (LEO) and geosynchronous orbit (GSO) satellite systems for mobile communications, attention must be given to the economic considerations governing their construction and launch. It is true that each LEO satellite is significantly cheaper to build and launch than a GSO satellite for systems of similar capability. Yet, given the fact that low earth orbits require many more spacecraft for complete earth coverage, and because LEO satellites last approximately 40%-50% as long in orbit as GSO satellites, the total number of spacecraft over the system's useful life will be substantially more. This generates a much higher cost to build and operate a LEO system over a similar period than a comparable GSO system.

Arguments have been made about the benefits of the "learning curve" when building large quantities of essentially identical spacecraft. We have found that although such downstream savings do occur, they tend to be relatively small and are often overshadowed by the huge investment in research and development. In fact, Motorola estimates that the average nominal flyaway cost of the replacement satellites for Iridium do not generate any recurring savings on average. If the non-recurring costs are applied to the initial constellation, the learning curve generates no more than a 20% savings[1] .

Table 1 illustrates the relative costs of building and launching different types of communications systems; two low earth with polar orbits and one geosynchronous. It is obvious that, on a per-unit basis, LEO spacecraft are substantially cheaper to build and launch. In addition, launch costs to geostationary transfer orbit are, on a per pound basis, roughly double those to low earth orbit. The extra weight of kick motors and hydrazine fuel boosts the total launch cost for each GSO spacecraft to many times the cost of each LEO satellite. However, because a GSO system requires only 2%-3% of the total number of LEO satellites over the life of the system, the aggregate costs to manufacture and launch a geosynchronous constellation are substantially less than Iridium and only double those of Aries, a system with far less capability.

When comparing costs per usable channel, it is even more readily apparent that a GSO system is, by far, the most economical solution. A major benefit espoused by LEO proponents is the fact that only low earth orbit systems offer total earth coverage. Because the highest latitudes are out of the range of visibility of GSO satellites, these systems cannot offer coverage near the poles. We have found, however, that, except for some marginal airline traffic over the northern polar regions, less than 0.5% of the world's population (primarily over Russia) is excluded from geosynchronous coverage[2]. Of the greater than 99% of the addressable market positioned within the realm of GSO systems, only about 5% exists over the oceans and about 3%-5% over the polar regions (roughly 1% from maritime traffic and approximately 7%-9% from intercontinental airline traffic). LEO systems, by their nature, must cover the globe with uniform capacity as they travel over the entire surface. Geosynchronous satellites can be tailored so that only a small percentage of the available channel capacity sits over the oceans. In addition, the proximity of low earth orbiting spacecraft over the poles causes significant beam overlap at the higher latitudes. Because of this, only 56% of Iridium's cells are turned on at any one time[3]. Other low earth, polar orbit systems suffer similar inefficiencies. Consequently, the combination of polar beam overlap and redundant ocean

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1 Global Personal Communications Satellite Services: Motorola Inc.& Lockheed Missiles & Space Co.,Inc., *Benefits of a Low Earth Orbit Constellation over a Geostationary Earth Orbit System*, Oct. 8, 1991, p.13.

2 The World Almanac and Book of Facts, 1992.
The Times Atlas of the World, 7th Edition.

3 Leopold, Dr. Raymond J., Low Earth Orbit Global Cellular Communications Network, Aug. 23, 1990, p. 7.

TABLE 1. LEO-GSO System Cost Comparison

PARAMETER	IRIDIUM LEO	TRITIUM GSO	ARIES[1] LEO
# of Satellites	77	3	48
Standby Satellites	7	1	4
Total # of Satellites per Life Cycle	84	4	52
Satellite Design Life (Years)	6	12	5
# of Satellites per 12 Years	220	4	136
Cost per Satellite ($M)	$13.4	$150.0	$3.0
Cost of Fleet for 12 Years ($M)	$2,948	$600	$408
Dry Weight per Satellite (lbs.)	950	6,200	275
Launch Cost per Satellite ($M)	$6.0	$194.0	$2.9
Total Launch Cost ($M)	$1,317	$776	$394
Insurance Rate	7%	18%	7%
Insurance Cost ($M)	$299	$248	$56
Total Space Segment Cost	$4,564	$1,624	$858

orbit systems have a total number of usable channels that is from 40% to 99% less than a comparable GSO system. Consequently, the cost per effective channel to implement and operate a LEO system is significantly greater. Table 2 illustrates this case in point.

In addition to cost, there are some practical tradeoffs that must be addressed. Hop delay is a seemingly unavoidable problem with geosynchronous range. However, as Motorola defines the addressable market, potential users will consist of those in need of emergency communications, those who have no available mobile service, those who have no telephone service at all, and those whose only mobile satellite service comes from geosynchronous spacecraft[2]. It is a well known fact that people who do not have access to a particular service and yet who desire that service will pay for its implementation and use, even though the quality is inferior to better, but unavailable substitutes. Every segment described above, except for the last, defines just this situation. In fact, users of Intelsat request a circuit change only 12% of the time when presented with an alternative[3]. Therefore, from a business viability standpoint, we have not yet seen a compelling argument demonstrating the negative effects of hop delay on the mobile satellite business. Demand should not be appreciably affected in the projected markets serviced by these global systems. Since a GSO system can be implemented less expensively, it should indeed be built since the savings will go to the consumer by way of lower service costs.

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1 Aries FCC Filing, June 3, 1991.

2 Leopold, Dr. Raymond J., Low Earth Orbit Global Cellular Communications Network, Aug. 23, 1990, p. 2.

3 Global Personal Communications Satellite Services: Motorola Inc.& Lockheed Missiles & Space Co., Inc.,*Benefits of a Low Earth Orbit Constellation over a Geostationary Earth Orbit System*, Oct. 8, 1991, p.13.

TABLE 2. LEO-GSO Cost per Channel Comparison

PARAMETER	IRIDIUM LEO	TRITIUM GSO	ARIES[1] LEO
Channels per Satellite	3,700	30,000	50
# of Satellites	77	3	48
Total System Capacity (Channels)	284,900	90,000	2,400
Reduction for Beam Overlap	0.56	1.00	0.57
Reduction for Ocean Coverage	0.29	0.90	0.29
Capacity Used by Maritime and Airline Traffic	1.10	1.01	1.10
Channel Usage Efficiency	18%	91%	18%
Effective System Capacity (Channels)	50,900	81,810	436
Total Space Segment Cost ($M)	$4,564	$1,624	$858
Total Space Segment Cost per Channel	$90,000	$20,000	$2,000,000

The second and perhaps the most important factor to consider is the inherent flexibility of a GSO system. The fact that the marketplace is dynamic and unpredictable warrants a set of satellites that can alter beam configurations and power requirements as demand concentrations change. A geosynchronous spacecraft can be tailored to the needs of the market. Intra-beam capacity can be altered from the ground without affecting the balance of the system because each cell remains stationary. LEO satellites must maintain constant power levels and channel capacities since they move over different areas of the globe. If local market demand evolves beyond the capacity of the satellites to absorb the changes, a LEO system will not be able to efficiently serve its customer base.

Finally, if the market does not develop as quickly in certain regions of the world, a GSO approach allows the phased implementation of the system by launching spacecraft only where they are immediately needed. This facilitates a workable system with only partial coverage. A LEO system, on the other hand, must be nearly fully launched in order to avoid unacceptable delays and sporadic connectivity. This increases the required initial investment to launch the business, even if demand does not warrant that level of available capacity.

Instrumentation

Hughes has recently studied a GSO MSS system, Tritium, which reflects the cited economic advantages. Nominal satellite locations for Tritium are 100° west, 20° east, and 140° east. These positions guarantee that all continents are covered, and that visibility crossover for a 5° elevation angle occurs at high latitude (62°) (Figure 1).

[1] Aries FCC Filing, June 3, 1991.

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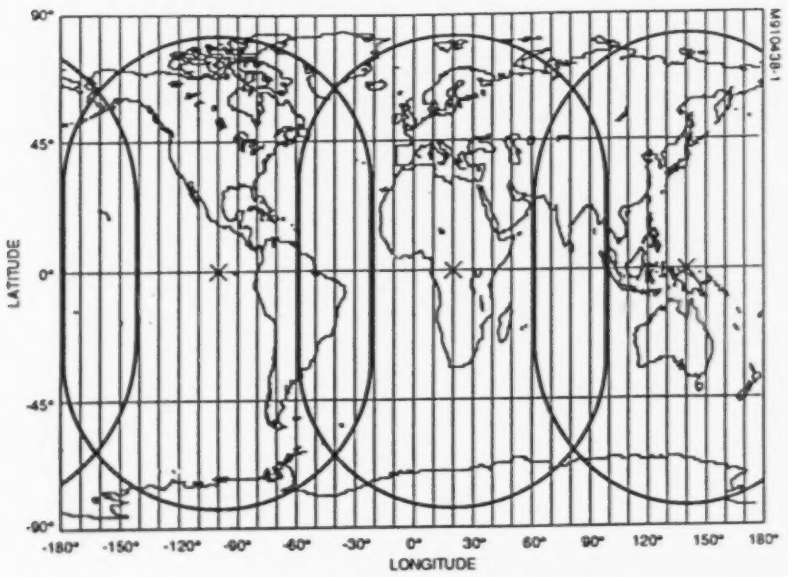

Fig. 1 Tritium system coverage

The global view from synchronous altitude is about 18°. With beams of 1° beamwidth, which can be obtained by use of a 55-foot antenna, visible earth coverage is achieved with about 290 beams. If only land masses are to be covered, the number of beams is 120 to 130, depending on which part of the world the satellite is located. Satellite weight and power constraints limit the number of beams to about 160. For full earth coverage, some ocean coverage beams are combined to form beams of 2° to 3° (Figure 2).

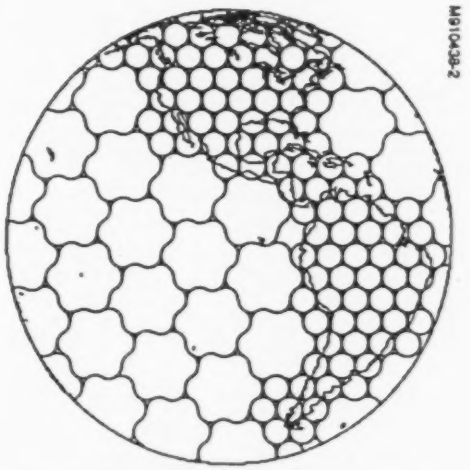

Fig. 2 America coverage beam zones
for satellite location at 100° w

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A satellite that provides cellular radio service by so many beams requires a lot of independent signal paths that do not cause mutual or intercell self-interference. Difficult functions of a multibeam satellite are diplexing of transmit and receive frequencies, interbeam connectivity, and RF-power distribution. Diplexing for a large number of beams can run into weight and space limitations. Therefore, one approach to avoiding diplexing would be to transmit and receive at time-interleaved intervals on the same frequency; this approach would also avoid passive intermodulation. Of course, it would require exact timing of the total network and digital burst transmission. But, with solid state power amplifiers (SSPAs), there are instrumentations available that assume some of the diplexing functions. The SSPAs produce low levels of intermodulation and cancel the out of band transmission, thereby avoiding the active intermodulation that falls into the receive band. Besides active intermodulation, there is passive intermodulation (PIM), which may fall into the receive band. Based on preliminary studies, it has been concluded that a certain amount of PIM can be tolerated and that dual frequency operation, i.e., separate frequencies for transmission and reception, is preferable over single frequency operation and precision transmission timing.

One of the most important decisions in making up a repeater architecture is to choose the method of interbeam switching. After careful system analysis, it has been concluded that with up to 160 elemental beams, the onboard processing required for complete interconnectivity is too complicated and the switching and processing functions have been relegated to the ground. The implication, of course, is a long transmission time delay for a full duplex system (about 600 ms) because the signal travels four times the length of the geosynchronous altitude.

The distribution of RF power in the various beams is another vexing problem. It would be advantageous if all the amplifiers could amplify all the signals, but this requires complex Butler matrices and fixed delays among antenna elements. Instead, it has been decided to have independent amplifiers (one per feed element) where the amplifiers have constant efficiency and use power only according to the number of applied carriers.

CDMA was selected as the preferred access approach since it offers the greatest frequency reuse and voice channel capacity. Also, CDMA is less susceptible for both multipath and multibeam interference, partly because interference adds mostly as noncoherent noise and partly because it can use a higher rate FEC and, therefore, a low Eb/No, without widening the bandwidth. Although FDMA has historically been preferred, today's microchip technology favors CDMA.

The mobile user who tries to make a connection has to ask for service on one of the network control channels, which is unique for any beam. By transmitting on one particular control channel, the network control center knows where the vehicle is located and will allocate a voice or data channel in that particular beam. If a mobile user is to be contacted, one has to know the position of the vehicle. For this purpose, its access code will be broadcast on all beams or in certain beam sectors where the user might be situated at that time. The user's response will indicate its position. Also, the position of mobile users can be obtained either by the user's forwarding position information, or by having the network control center monitor the control channels and memorize the last position. For network control and interlinking, all global and local area network control stations will be interconnected by Ku-band links.

CDMA and Mainlobe Interference

Studies show that CDMA mainlobe interference is the primary source of degradation and sidelobe interference is of secondary concern. Since CDMA must use a wide bandwidth for interference rejection, one cannot slice up the total transmission bandwidth into small pieces. If one uses a 14 MHz band, each beam has the same frequency, and a user at the crossover of three beams suffers the interference from 3n-1 friendly users. In the satellite visibility crossover zone the

interference would double unless different polarizations are used on adjacent satellites. If the band is divided into three frequencies, adjacent beams do not have the same frequency and the user at the crossover zone of three beams suffers only the interference of n-1 friendly users. However, the WT product, i.e., the transmission bandwidth times the bit period product is lower because the spread bandwidth W has been divided by 3 and, consequently, the interference rejection is reduced. Analysis shows that it is better to use the larger bandwidth and accept the 3n-1 interference than to reduce the bandwidth. Since each beam uses the full 14 MHz, about 64 beams will fill up 1000 MHz. To accommodate 160 beams 2500 MHz are required, which must be partitioned among several Ku-band earth stations residing in different geographical areas and operating on a dedicated Ku-band spot beam.

CDMA Links

The L-band and Ku-band beam EIRP budgets are given in Table 3. The edge of earth L-band beams have a 4 dB gain defocusing loss. Table 3 also shows the expected gain over temperature ratio (G/T) budgets of both L-band and Ku-band receivers.

TABLE 3. TRITIUM EIRP AND G/T BUDGETS

Parameter	L-band EIRP, dBW		Ku-band EIRP, dBW
	Edge Beam	Center Beam	
HPA output power, dBW	9.0	10.0	14.0
Output losses, dB	–1.3	–1.3	–2.0
Antenna gain, dB	41.3 (EOC)	41.3 (EOC)	35.0 (Center)
Scan loss, dB	–4.0	0.0	0.0
EIRP per beam, dBW	45.0	50.0	47.0 (max)
	L-band G/T, dB/K		
	Edge Beam	Center Beam	Ku-band G/T, dB/K
Antenna Gain, dB	41.0 (EOC)	41.0 (EOC)	35.0 (Center)
Scan loss, dB	–4.0	0.0	0.0
System temperature, dBK	28.0	28.0	28.0
G/T, dB/K	9	13	7.0

CDMA link performance calculations represented in Table 4 show that with a rate 1/3 FEC and a WT product of 34.5 dB all CDMA links can support 125 to 250 carriers per beam, depending on beam pointing, and that CDMA provides a high link margin (4 dB) against its own low Eb/No of 4 dB. The CDMA links also indicate that it is best to use the widest bandwidth for optimum signal to noise ratio. It should be noted that signals transmitted

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TABLE 4. TRITIUM LINK BUDGET, CDMA

Downlink	L-band (edge beam) (1550 MHz)	L-band (Center Beam)	Ku-band Downlink
RF power per beam, dBW	9.0	10.0	14.0
Backoff, dB	—	–	–4.0
RF loss, dB	–1.3	–1.3	–2.0
Antenna gain, dB	41.3	41.3	35.0
Scan loss, dB	–4.0	0.0	–1.0
Total EIRP per beam, dBW	45.0	50.0	42.0
No. of carriers, dB	–21.0	–24.0	–36.0
	125 channels	250 channels	4000 channels
Voice activation, dB	4.0	4.0	4.0
EIRP per carrier, dBW	28.0	30.0	10.0
Path loss, dB	–188.8	–187.4	–205.6
Receiver antenna gain, dB	+4.0	+4.0	50.0
Received carrier, dBW	–156.8	–153.4	–145.6
K, dBW/kHz	–228.6	–228.6	–228.6
B, dB/Hz	71.5	71.5	71.5
T, dBK	24.0	24.0	22.0
N, dBW	–133.1	–133.1	–135.1
(C/N) d, dB	–23.7	–20.3	–10.5
C/IM, dB	–2.0	–2.0	–2.0
C/I (side lobe), dB	–14.0	–14.0	—
(C/N) up, dB	–16.5	–16.5	–22.3
Cochannel interference, dB	–21.8	–24.8	–24.8
C/N, dB	–26.5	–26.5	–26.5
WT, dB	+34.5	+34.5	+34.5
Eb/No, dB	8.0	8.0	8.0
Eb/No required, dB	4.0	4.0	4.0
Margin, dB	4.0	4.0	4.0
Power flux density in 4 kHz, dBW/m^2	–154.0	–149.0	

C/IM = NPR—number of channels in beam (15–17) = –2 dB

(C/I) per beam = C/I —number of interfering sidelobe beams—number of channels

= 13-10-17 = –14 dB

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from cell to cell are going up in L-band, then down in Ku-band to the network switching center, where signals will be demodulated and remodulated and noise will be removed. Therefore, there is only one hop of effective satellite link noise to be accounted for. The L-band downlink carrier to spectral noise density received through a 4 dB gain antenna is 45 dB Hz. The edge beam power flux density in 4 kHz on the earth surface is -154 dBW/m^2, which meets Radio Regulation requirements at 0° to 5° elevation. The center beam produces a power flux density of -149 dBW/m^2 per 4 kHz, which is 5 dB below the maximum allowable limit of -144 dBW/m^2 per 4 kHz at high elevation angles.

The number of channels per beam can also be calculated from the following equation:

$$m_{CDMA} = \frac{(No/Eb)\ WT}{a\left[L_{im}(1 + \frac{1}{K})\ A_{fb} + (N/C_T)_d + L_{im}\ (N/C_T)_{Kuup}\right]M}$$

where

(N_o/E_b)	=	Required noise density to bit energy ratio
(N/C_T)Ku up	=	Noise to total power ratio of the Ku-band uplink
$(N/C_T)_d$	=	Noise to total power ratio of the downlink
WT	=	RF bandwidth X bit-period
L_{im}	=	1.04 degradation in detection due to IM (at 15 dB NPR)
K	=	10 Gaussian fading factor
A_{fb}	=	3.4, main lobe and sidelobe interference factor
a	=	Voice activation factor (0.4)
M	=	Link margin

Tritium-CDMA Communications Payload

The Tritium-CDMA repeater is shown in Figure 3. In case of the forward link, Ku-band signals are transmitted from several master control stations (MCSs) within two 500 MHz bands (per beam), in two planes of linear polarization in 14 (15.6) MHz slots, and are downconverted to C-band. From C-band they are further downconverted to L-band, where filters will select a 14 MHz band associated with each L-band beam. After filtering, signals will be fed to the transmit chain, which consists of channel control unit/linearizer and a 10 W SSPA. The amplified signals are then routed to the L-band diplexer and from there to the L-band feed. On return, L-band uplink signals, collected by a single beam, are amplified and filtered by 14 MHz filters. Then, the elemental beam bands of 14 MHz each are converted to C-band. Up to 64 bands of 14 MHz are combined by an odd-even output multiplexer, after which separate bands of 32 X 15.6 = 500 MHz are upconverted to Ku-band and transmitted to the MCSs, which are in different parts of the satellite viewing area. For the purpose of interconnecting all network control and gateway stations and for interlinking, there is a Ku-Ku-band interconnection and distribution network. At the MCS, inbeam and interbeam switching and other operations which are necessary to clean up transmission are performed.

One building element necessary for the success of a Tritium-like satellite mission is the HPA with constant efficiency. Constant efficiency means that over a wide dynamic input power range the HPA requires a dc power proportional to the applied input power. Thus, when amplifiers do not require the allocated average dc power, the excess is available to other amplifiers, which may have

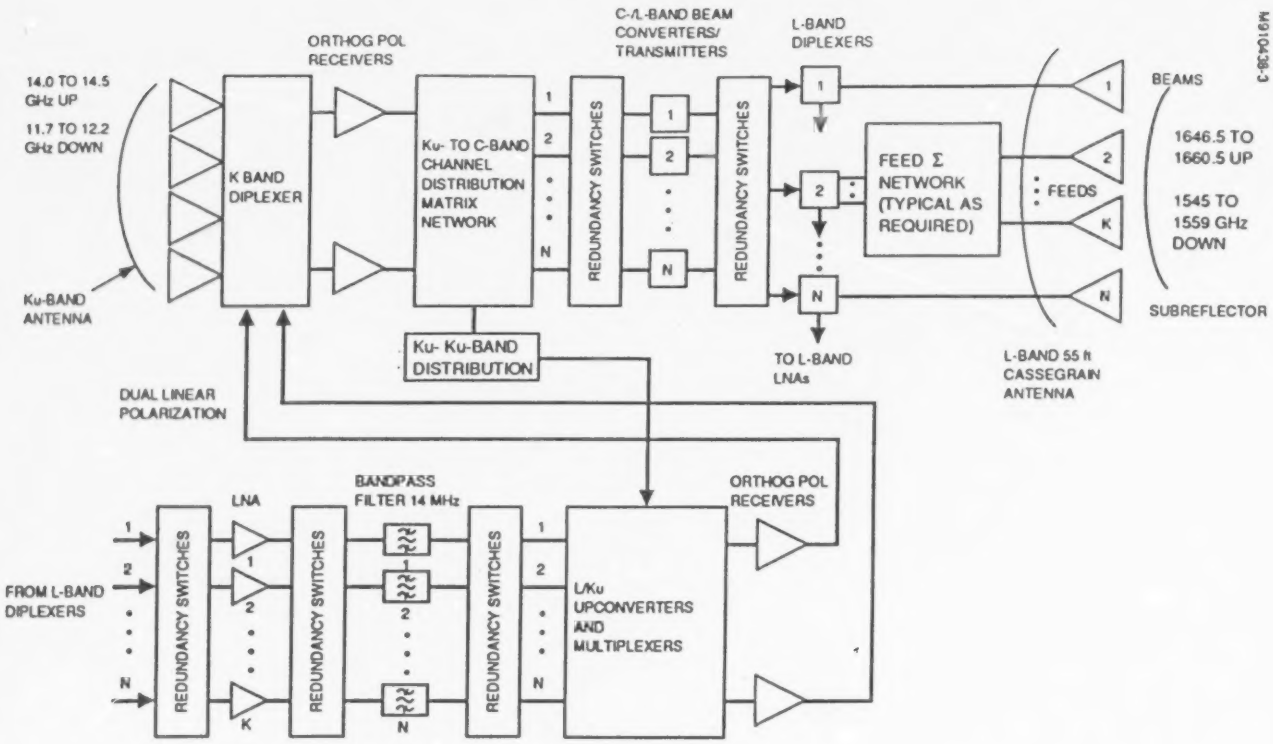

Fig. 3 Transponder

a higher carrier demand. Thus, there is a limited dc power transfer available from those amplifiers with little traffic to those with above average traffic. The center beams have a 5 dB dynamic range margin before their flux density limits are reached.

The L-band antenna consists of a 55 feet cassegrain reflector, which is attached to the body-stabilized Hughes HS 601 bus, and a subreflector, which is held in place by a tripod. The Ku-band antenna is mounted on the other side of the subreflector. The reflector is constructed of a wire mesh, which permits sunlight to reach the solar panels.

Tritium System

The link calculation shows that 125 mobile voice links of 4.8 Kbps can be supported by beams at the edge of the satellite visibility zone and 250 links can be supported by beams at the sub-satellite points. The Ku-band link is laid out for the average expected traffic of 160 beams or 160 X 187.5 @ 30,000 carriers. This requires a total Ku-band width of 160 X 15.6 = 2500 MHz. If this bandwidth is distributed among 10 gateway stations, each station has to transmit on its Ku-band link less than 250 MHz.

The payload weight and size is such that an Ariane 5 launch vehicle is required. A sketch of the Tritium satellite is given in Figure 4.

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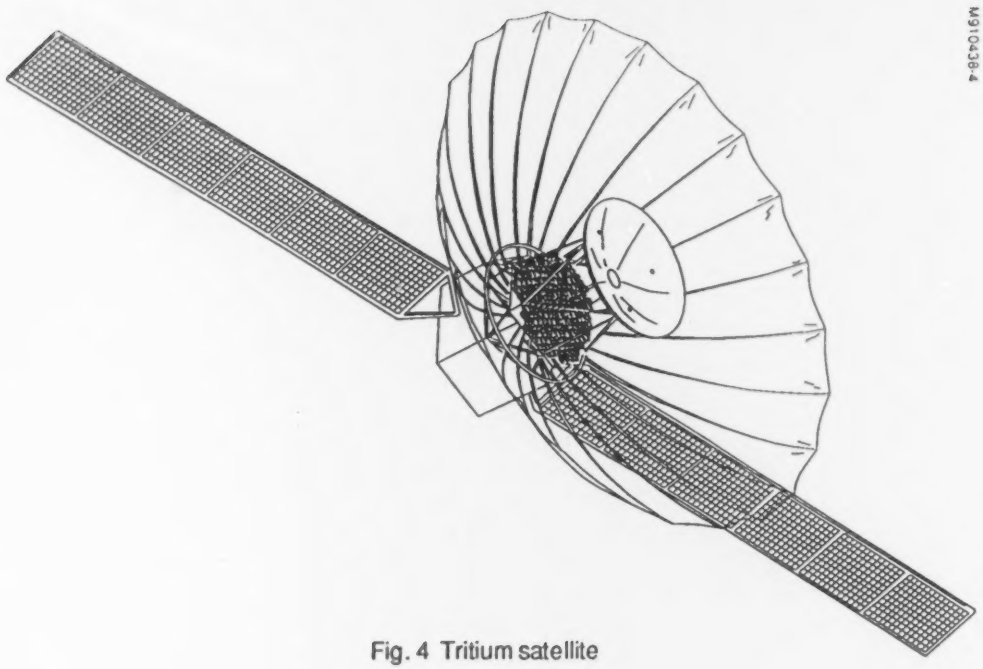

Fig. 4 Tritium satellite

In summary, the main Tritium features are the following:

- Augmented body stabilized HS 601 bus (6 panels)
- 55 feet L-band cassegrain antenna
- 160 L-band beams (N)
- 1646.5 to 1660.5 MHz mobile uplink
- 1545 to 1559 MHz mobile downlink
- 14 MHz total L-band bandwidth
- 14 MHz per L-band beam
- N X frequency reuse
- Interbeam communication
- Constant efficiency L-band SSPAs
- 30,000 mobile channel capacity per satellite
- 90,000 total Tritium system mobile channel capacity
- Ariane 5 launch vehicle
- Mission life 12 years

Conclusion

It is evident that a GSO system provides a more economical solution than LEO for mobile satellite communications. A global system using geosynchronous satellites is within the possibility of today's technology. The allocation of scarce frequency spectrum to service providers must be restricted to those who can best serve the needs of the public. It is therefore difficult to justify the obvious waste of resources, both spectral and financial, by constraining MSS to LEO systems. The most sensible alternative may be the implementation of geosynchronous mobile communications.

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Global Networks
The Challenge of Creating a Global Network

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Socioeconomic changes in the world make the countries in the world more and more interdependent on each other. Telecommunications are required to play a catalytic role to develop this trend further. KDD is making an effort to meet this requirement by offering to customers end-to-end services. This paper describes how KDD is aiming at achieving this objective.

1. Introduction

The changes taking place in today's world are truly revolutionary. The tearing down of the Berlin Wall was one of the most dramatic in a series of events that led to the easing of East-West tensions and political transformations whose repercussions will be felt for decades, if not centuries, to come. At the same time, the increasingly "borderless" activities of corporations everywhere have ushered in a new era of globalization and growing interdependence in every aspect of business and economics. As a consequence, we are witnessing an expansion in the scale and scope of human activity that is unprecedented in history. Inevitably, the spotlight is now on communications in the true sense of the word. This, in turn, is accentuating the importance of international telecommunications, which have always been the primary means by which people have communicated over international boundaries.

KDD's response to these dramatic events has been to initiate the development of a global network designed to provide end-to-end customer support. I would like now to take a closer look at some of the actual steps we are taking.

2. Streamlining the International Trunk Communications Network.

There are two types of international telecommunications networks, satellite and cable, but in my talk today I shall focus on the transpacific submarine cable network. The bed of the Pacific Ocean already accommodates many submarine cables, as you can see from the first figure. Of these, optical fiber submarine cables have played a particularly significant role in handling the rapid increase in telecommunications traffic across the Pacific. In April 1989, KDD and twenty-nine other telecommunications carriers from fifteen countries around the globe joined together to begin operating HAW-4/TPC-3, the first optical fiber transpacific submarine cable. On a 64 kbps conversion basis, its capacity is equivalent to 7,560 circuits, making it the core of the current transpacific network.

However, the rapid increase in the volume of telecommunications has made it necessary to construct a new cable, TPC-4, which is scheduled for completion in October 1992. This optical fiber submarine cable will also have a very large capacity: on a 64 kbps conversion basis, its capacity will be equivalent to 15,120 circuits. As I am sure you know, optical fiber submarine cables have higher quality and larger capacities than conventional coaxial cables, so they have become an indispensable means of meeting the rapidly growing demand for telecommunications capacity across the Pacific Ocean. Nevertheless, the astonishing increase in transpacific telecommunications traffic means that even when the new cable mentioned above comes into operation, there will not be sufficient capacity.
For this reason, plans for the construction of TPC-5CN are already well advanced. TPC-5CN will be constructed of high-volume optical fiber submarine cables providing, on a 64 kbps conversion basis, a capacity equivalent to 60,480 cir- cuits in a two-pair configuration connected in a loop. In fact, the TPC-5CN's design incorporates

a revolutionary new concept - the self-healing system - which is illustrated in Figure 2. When a conventional submarine cable breaks down, we have to rely on satellite circuits or other cables for back-up until it is repaired. In contrast, each cable in TPC-5CN has its own independent back-up one on cable. By using two pairs for the circuits, the spare pair can take over for the first pair should it break down. Constructing the cables in a loop configuration allows transmissions to be switched to other cable on the loop should faults develop in both pairs.

Because the system permits instantaneous switching through the same transmission medium, it allows the provision of a secure and highly reliable network. Any future plans for laying optical fiber submarine cables are bound to place as much emphasis on security and reliability as on capacity.

Ordinarily, the optical signal transmitted inside the cable attenuates with the distance it travels, so that at set intervals it must be converted to an electric signal and regenerated. This requires submersible repeater. KDD has developed the technology to simplify repeaters in such a way that they amplify the attenuated optical signal as light without converting it to an electric signal. Because these simplified repeaters have fewer components, they are expected to provide greater reliability and allow larger signal volumes to be transmitted. Naturally, these repeaters will be used in the TPC-5CN cable. More details of the new optical amplifier will be given at another session.

When, constructing an optical fiber submarine cable, it is important to increase the reliability of the cable itself, but more important is its maintenance; the maintenance system which enables rapid repair and quick restoration of the traffic when breakdown occurs. KDD is presently building a new cable ship, the KDD Ocean

Link, which is scheduled in commission in February 1992, in addition to the KDD Maru which KDD presently uses for laying and maintaining submarine cables. She will carry the latest cable-laying equipment and a large-capacity cable tanks that will allow her to lay about 4,500 km of cable at one time. She will also be made highly maneuverable so as to facilitate the laying and repair of cable under the harsh ocean conditions of the North Pacific.

KDD has thus adopted an overall approach to building and improving the international trunk network which not only ensures that sufficient capacity is in place to handle telecommunications traffic, but also provides safer, more reliable circuits with an established maintenance system.

3. Improving the Domestic Telecommunications Network of the corresponding countries

When international telecommunications are seen as end-to-end services, it is obviously important to take the domestic network of the corresponding countries into consideration as well. The condition and status of domestic networks vary widely from country to country. In some countries, expanding or enhancing domestic networks to meet customer demand requires such vast sums of cost that a single enterprise cannot possible provide the finance. KDD is active here, too. As mentioned at PTC '91 last year, KDD, AT&T and the Ministry of Posts and Telecommunications of People's Republic of China are working together on the PRC Digital Network Project, for example. International telecommunications between Japan and China are currently handled by an Intelsat satellite and by the Japan-China submarine cable. Demand for high-quality digital transmission is growing among the users in China, however, the cable is expected to reach full capacity by the mid 1990s. It is thus imperative that the domestic and international telecommunications

networks be improved.

The PRC Digital Network Project was designed to meet this need. As illustrated in Figure 3, the first stage of the project calls for the use of local distribution radiowaves (LDRs) that employ digital microwaves to provide direct links between buildings in which customers are concentrated and an IBS urban gateway earth station installed on the roof of a Ministry of Posts and Telecommunications building. Digital leased circuit services will be provided via the Intelsat satellite over the Pacific Ocean.

This project will enable high-quality international digital transmission paths to be established via satellites in a short period of time. By redirecting international traffic that was previously handled on the domestic telecommunications network to these new links, the scheme will do much to reduce the burden on the domestic network. Services are expected to begin in the very near future.

As an extension of this project, the second phase calls for the construction of a Japan-China optical fiber submarine cable, which is scheduled to go into operation offering full-scale digital transmission services between Japan and China at the end of 1993.

While each country is basically responsible for building and enhancing its own domestic networks, one of KDD's goals is to contribute by making its technology available to countries that need it.

4. Services Provided with over the enhanced networks

Telecommunications services are faced with the task of satisfying a rapidly diversifying range of customer needs. Simply providing transmission routes does not meet the demand for full end-to-end services. To cope with the situation, KDD has adopted a number of

approaches, particularly with regard to corporate customers whose needs are especially diverse and sophisticated.

It is becoming increasingly clear that in order to operate in the borderless international market, today's businesses require high-capacity networks that provide real-time global links around the clock. At the same time, as they begin to use telecommunications in a more sophisticated manner, the construction of an efficient corporation network is an important part of any corporation's business strategy. As a result, corporations are not only demanding safer, more reliable networks, but are also moving toward integration of voice, images and data in a multi-media environment.

Another key trend in the creation of corporate telecommunications networks is "outsourcing." Corporations are finding it makes sense to concentrate on the areas of business where they are strongest, and entrust the implementation of networks and systems to the telecommunications providers who possess the necessary advanced technology and know-how. To meet this trend, KDD offers a line-up of the services called "KDD PLANS" which provide customers with comprehensive support for a wide range of networks, as shown in Figure 4.

As part of these services, KDD recently started offering the integrated network management service PLAN-M. Network monitoring equipment installed on KDD's premises provides total systems management and maintenance for customers, end-to-end, between Japan and abroad. PLAN-M deals with breakdowns speedily and makes it easier to control and analyze service quality. The SYSTEM-PLAN network service, on the other hand, lets customers use a system constructed on KDD's premises to build their own made-to-order system, while the PORT-PLAN network service provides a ready-made network by connecting the required customer cir-cuits to a system

on KDD premises. As part of another service, PLAN-H, KDD provides space on its own premises for customers who want to build a network with their own telecommunications equipment, and monitors, operates and maintains the equipment on the customers' behalf. Finally, under PLAN-E, KDD makes use of its own expertise in a consulting engineering service to support customers designing their own networks.

By using these services, customers can create more sophisticated networks in shorter timeframes with greater safety. Combining the services increases the benefits of implementing networks that use integrated management, thus enabling KDD to provide finely honed services that meet customer requirements exactly. Many of KDD's customers are already enjoying the benefits of these enhanced services.

At the same time, KDD is introducing new features to meet demand for more sophisticated capabilities in public networks. Using the optical fiber submarine cables and digital satellite technology described earlier, KDD now offers international ISDN service to 11 countries, including the United States, Britain, France, Australia and Singapore, with service areas to be expanded in the future. KDD's next step will be the introduction of broadband ISDN service which should help satisfy the growth in demand expected to result from heavier traffic, such as in highquality audiovisual communications.

By providing an array of databases in the network, KDD can also provide services that offer higher added value. KDD already provides intelligent network services such as Auto-Credit Card Call and Free-Phone Service. Most recently, it has started providing international Virtual Private Network (VPN) services. These services allow customers to "tell" the network how they want to pay charges, dial destination numbers, and so on. Although these services are still at a rather primitive level, we

consider them an important first step toward full-scale intelligent network services that include UPT service.

These endeavors are designed to transcend the ultimate dream of "face-to-face" telecommunications by providing tools that help people and implementing a global network that is intimately intertwined with human activities.

5. Global Carrier Cooperation

One critical factor in the programs and endeavors I have discussed to this point is the vital importance to the implementation of a global network of international cooperation and linkages between carriers. Obviously KDD cannot do it alone.

For international end-to-end telecommunications, the carriers in the originating and destination countries must work together. There are two possible types of carrier tie-up classified in line with the implementation of a global network. The first is characterized by the construction of the trunk line networks themselves, such as optical fiber submarine cables, or the establishment of carrier tie-up in the implementation of ISDN. An example of the second is the provision of services by groups of multiple carriers under joint brand names. This has been a particularly promising method of expanding new services and is making a major contribution to the globalization of such new services.

One service that KDD offers using the latter format is "one-stop shopping," which enables customers to integrate any requirement to a single contact point of carriers within the framework of the international leased circuit service and many customers have made use of this service. The Joint Network Initiatives (JNI) Project has been started since last year. JNI is a joint effort between AT&T, British Telecom, France Telecom and KDD to set up an

international telecommunications network that provides worldwide support to multinational corporations. Customers who wish to implement an international network employ the four telecommunications companies to put together a lateral, joint project team that provides circuits, delivers, maintains and operates equipment, and manages the network. This system guarantees end-to-end telecommunications within the four countries, integrates all points of contact when the network is set up, and delivers higher quality services with a shorter set-up time. Spain's Telefonica and Germany's DBP Telecom are also going to join the project. Further joint projects with overseas carriers are also under consideration at KDD.

In addition to this type of tie-up, KDD works through the KDD Group's overseas subsidiaries, as illustrated in Figure 5, to provide end-to-end customer support in the form of consulting and other services.

In the context of implementing a global network, it is also vital not to overlook the importance of technical assistance to developing countries. Cooperation with developing countries is an essential element in the planning, creation and extension of the telecommunications infrastructure to ensure greater universality and compatibility in the sphere of international telecommunications. KDD has long been active in such assistance and will continue to work with developing nations to improve their international telecommunications.

6. Conclusion

To conclude, KDD is working toward the construction of a global network through the many projects in which it is involved. These include the building of a trunk line system for domestic and international communications that incorporates maintenance and operational functions, responding to corporate

demand for more sophisticated services that utilize these networks, incorporating more intelligent features into a wider portion of the network itself, and working globally with other carriers on the development of the new technologies necessary for the proper implementation of these projects. In light of the revolutionary changes taking place in international society today, the provision of end-to-end services is vital to ensuring communications in the truest sense of the word. We look forward to facing these continuing challenges.

Figure－1

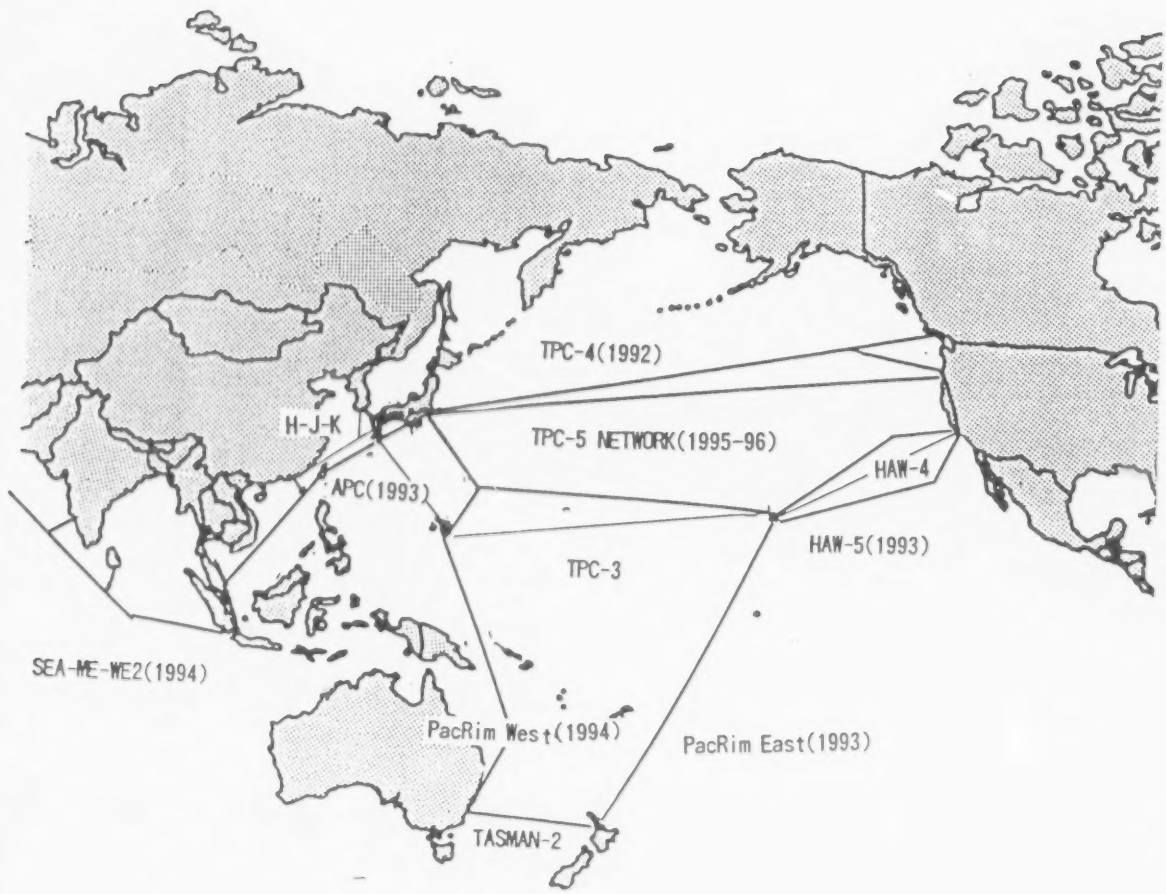

TPC-4(1992)
H-J-K
TPC-5 NETWORK(1995-96)
HAW-4
APC(1993)
HAW-5(1993)
TPC-3
SEA-ME-WE2(1994)
PacRim West(1994)
PacRim East(1993)
TASMAN-2

Figure-2

TRAFFIC DIVERSITY AND SELF-HEALING FIBER-ON-FIBER RESTORATION

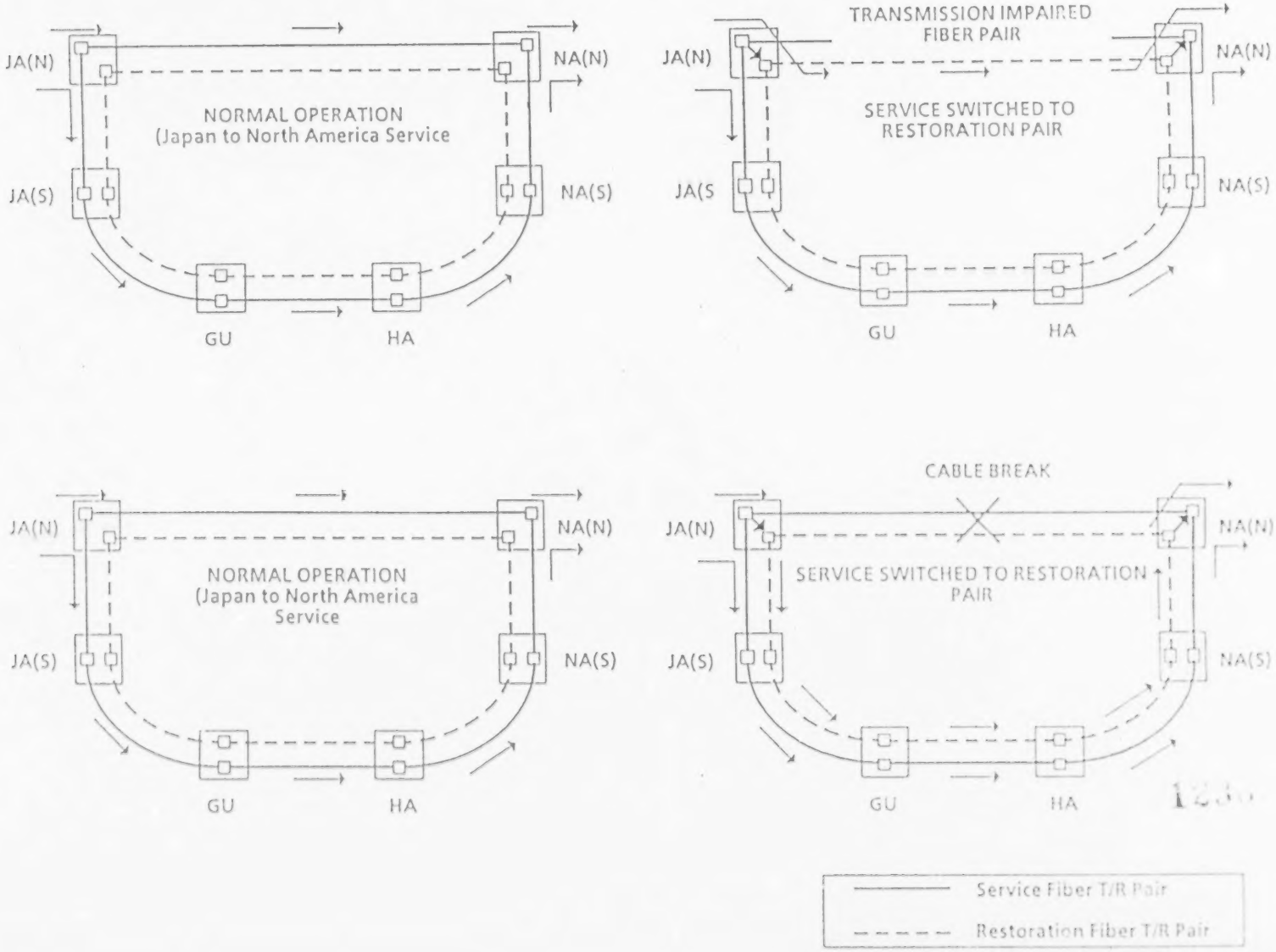


Figure-3

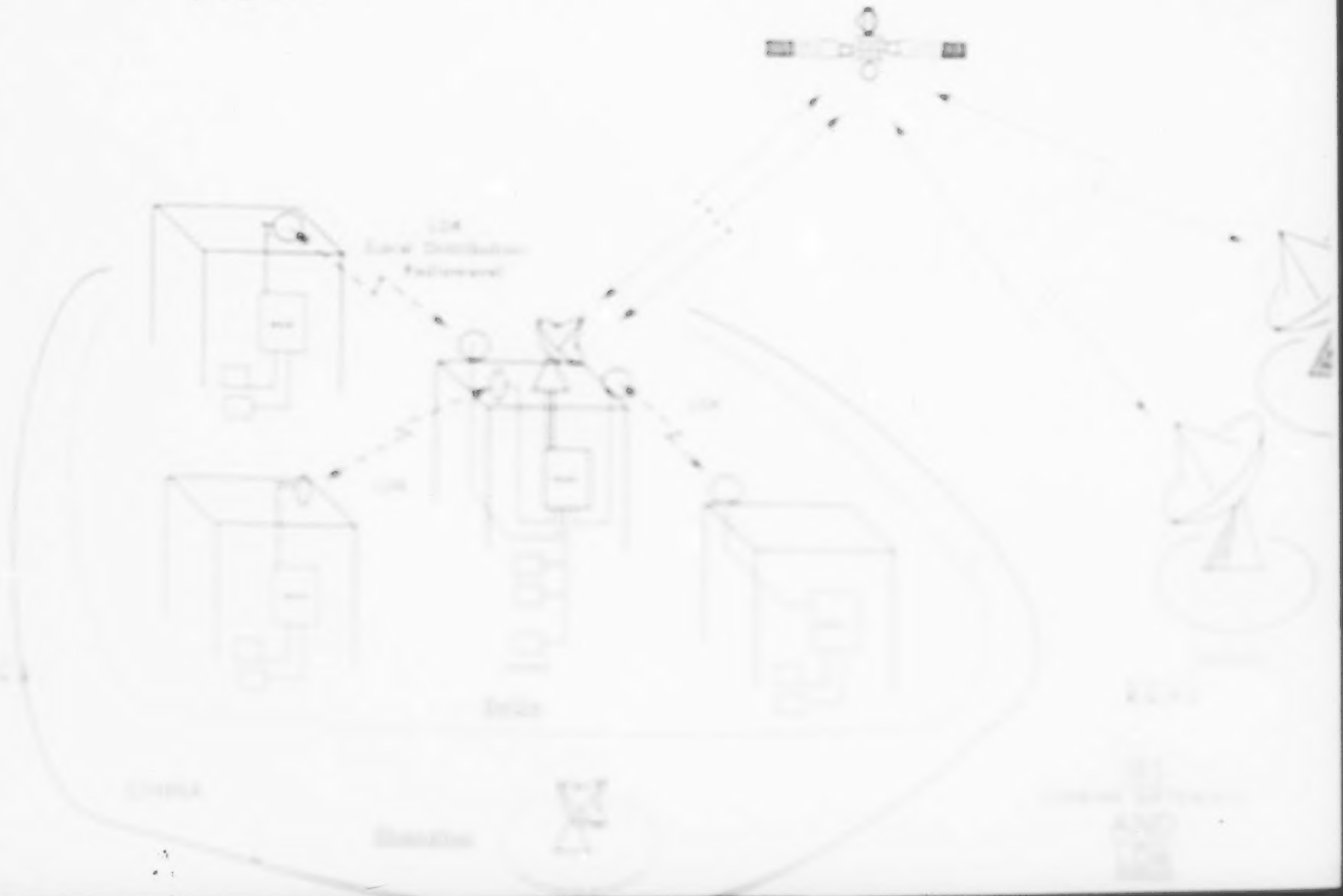
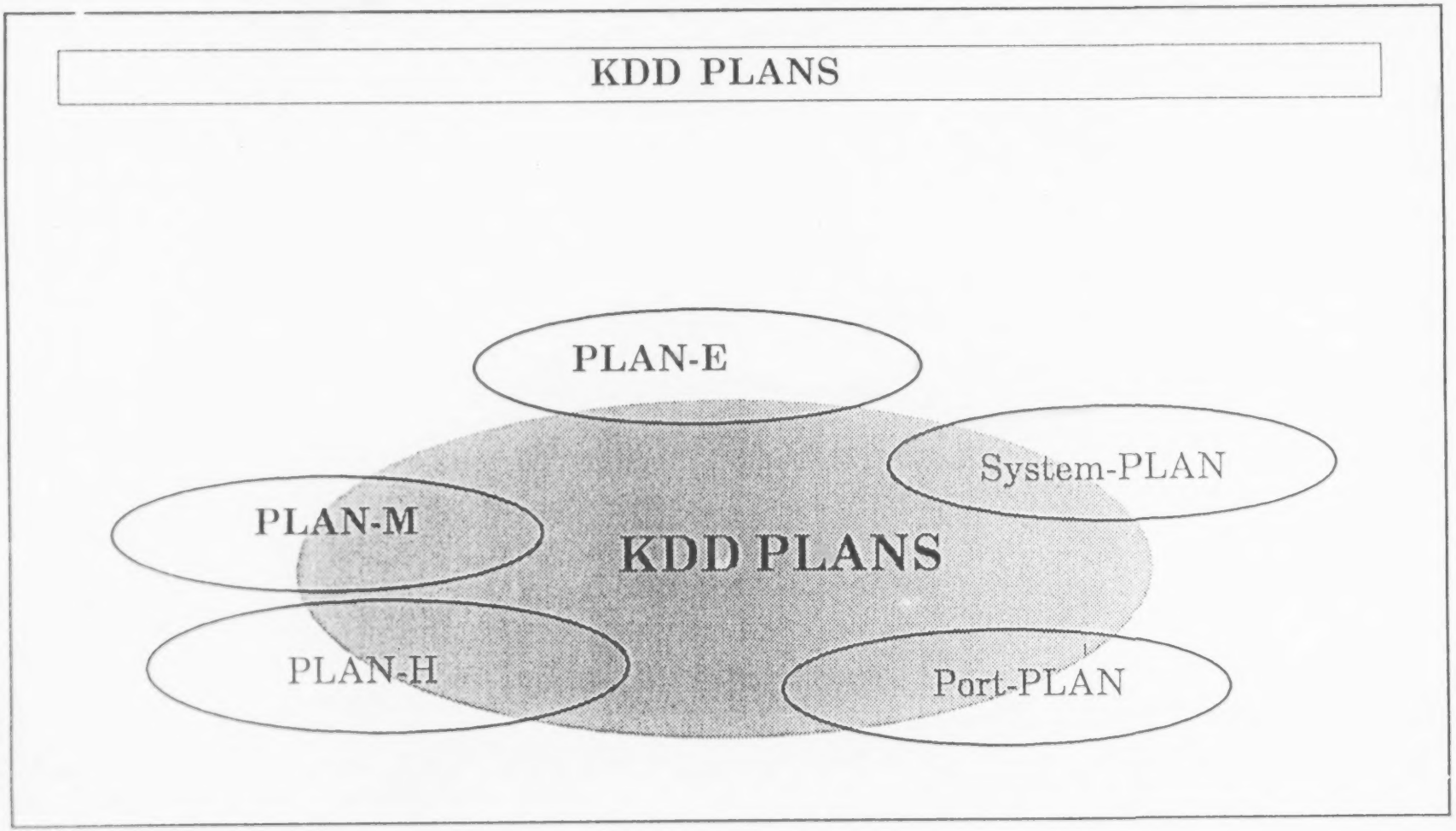


Figure-4



Figure－5

KDD GROUP COMPANIES ABROAD

AS OF OCTOBER 1991

NAME OF COMPANY	PRESIDENT	PLACE OF OPERATION	DATE OF ESTABLISH-MENT	CAPITAL	NUMBER OF EMPLOYEE	REVENUE IN YEAR ENDED MARCH 1991	CAPITAL CONTRIBUTION OF KDD
Telecomet International Inc. (TII)	N. OHYAMA	TOKYO, OSAKA, BEIJING	1984.11 1990. 5	¥1440M	200	¥6811M	KDD : 80% OTHER : 20%
Telecomet Inc.	A. YAMAMOTO	NEW YORK, LOS ANGELES, SFO, CGO	1981. 7	US$ 3M	124	US$10.7M	TII : 60% KDD AMERICA: 40%
Telecomet International Ltd.	A. SHIMIZU	LONDON	1984. 11	£400,000	26	£4.8M	TII : 75% KDD U.K. : 25%
Telecomet International GmbH	M. FURUYA	DUSSELDORF	1986. 1	DM800,000	10	DM 2.4M	
Telecomet International (S) Pte. Ltd.	H. DATE	SINGAPORE	1989. 12	Sin$ 300,000	5	Sin$ 800,000	TII : 100%
Telecomet International H.K. Ltd.	S. TOYODA	HONG KONG	1990. 4	HK$ 1.5M	4	HK$ 2.8M	

PRINCIPAL SERVICES OF TELECOMET GROUP: DEVLOPMENT, MANUFACTURING, SALE, MAINTENANCE AND CONSULTATION OF INFORMATION AND COMMUNICATION SYSTEMS

NAME OF COMPANY	PRESIDENT	PLACE OF OPERATION	DATE OF ESTABLISH-MENT	CAPITAL	NUMBER OF EMPLOYEE	REVENUE IN YEAR ENDED MARCH 1991	CAPITAL CONTRIBUTION OF KDD
Telehouse International Corporation of America	N. FUJI	NEW YORK	1987. 6	US$ 30M	52	US$ 4M	KDD : 25% NRI : 20% KAJIMA : 7% OTHER : 48%
Telehouse International Corporation of Europe Ltd	K. FUKUDA	LONDON	1988. 3	£15M	29	£3M	KDD : 33% NRI : 23% BT : 12% OTHER : 32%

PRINCIPAL SERVICES OF TELEHOUSE GROUP: PROVISION OF FLOOR SPACE TO ACCOMODATE COMPUTERS AND COMMUNICATIONS EQUIPMENT, 24-HOUR MAINTENANCE AND SECURE OPERATION SERVICE, AND CONSULTATION SERVICE ON PLANNING, IMPLEMENTATION AND MANAGEMENT OF COMPUTERS AND COMMUNICATION SYSTEMS.

Presented at PTC '92 by:

Mr. Mike Israel
Director of International Affairs
Teleglobe Canada Inc.

The Keys to Success: Teleglobe Canada's Successful Transition from Government Carrier to Private Sector Telecommunications Concern

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Abstract

Since privatization in 1987, Teleglobe has emerged as a world-class information technology and telecommunications corporation. The keys to success have proven to be very similar at both the micro and macro levels of our organization: interpersonal, interdepartmental, intercorporate and international. Modeled on the dynamic transformation since privatization of our previously engineering-oriented corporate culture, this presentation outlines the revolutionary post-privatization changes at Teleglobe that have poised us for success in the international marketplace.

Four years after its privatization, Teleglobe Canada is well on its way in the transition from a government-owned crown corporation to a private competitive business enterprise. During this rather complex process we put a great deal of thought into the potential for our corporation — and we realized that we had the capacity to be much more than the telecommunications carrier we were a number of years ago.

Today, our clear, responsive, customer-oriented vision has led us to become a world-class, billion dollar, international communications and information technology corporation. As I will reveal through this analysis, modeled on the four-year evolution of our corporate culture — a previously technologically-oriented and engineering based culture — the

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pattern for our corporate success in the international communications marketplace has become clear.

At the time of privatization, in 1987, Teleglobe Canada's raison d'etre was the maintenance and growth of the *international network.* Our mandate was to provide technical excellence and high-quality expansion — to provide the installations and facilities required to operate an efficient international telecommunications network. This technological approach has been described as the "*gold-plated approach*": providing long-term, highly complex solutions, that — although impressive and technically first-rate — were often costly, generally developed in isolation, and (due to a frequently protracted development and implementation framework) often no longer responsive to the rapidly-changing demands of the marketplace when they were eventually introduced.

This was typical of what we recognize today as the carrier approach: focussed on technical excellence, steadfast perfection and response to the *corporate* network demands with expert know-how. We were also unregulated. But this meant that the scope of business activity of a government-owned entity was strictly limited to specific domains: the development of an international telecommunications infrastructure to serve Canadian needs; fulfillment of a number of governmental socioeconomic objectives dictated by national policy considerations; and discharging a number of

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governmental obligations within international organizations including technical assistance and multi-lateral developmental activities.

Privatization and regulation brought significant and immediate change to Teleglobe. Issues such as *return on equity* and *rate reduction* compelled us to scrutinize our performance and productivity standards. In response, we reduced our rates by almost 40% in four years. We negotiated a tarif scheme with our national and international partners that allowed us to be competitive in a global context and — given Canada's geographical situation— particularly vis à vis our American counterparts. The changeover to a private company culture also lead to the development of the successful customer-oriented vision that Teleglobe has today. Satisfying customer demands is indeed, in our view, the optimum measure of business success.

Privatization redirected the focus of our corporation outward. In the late 1980's, terms like *partnership*, *customer*, *competitiveness*, *business solution*, *flexibility* and *opportunity* began to gain a foothold in the Teleglobe Canada vernacular. Among the many initial organizational changes reflecting this new focus, the Engineering & System Development Department was renamed the Network Development Group and was given the new mandate to examine the goals of network development from the perspective of the customer, and the services that would satisfy their requirements in terms of

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quality, diversity and cost. *Whose needs were we answering?* Could we provide quick, high-quality solutions that reduced overall communications costs for our customers; that responded quickly and affordably to their needs; and that made Teleglobe a more successful enterprise? The clear answer was "*yes*".

From this simple, yet important, realization — the keys to success came within our grasp. Drawing upon the marketing-driven, entrepreneurial spirit of our new parent corporation, Teleglobe began the process of positioning itself as the competitive, customer-focussed, world-class corporation we have become today. The new Teleglobe represents a family of international business units that, together offer products, systems, services and end-to-end support to help our customers communicate with their world.

Our Communication Services unit, which includes Teleglobe Canada — and our Marine, International, and Information Management companies — provides international communications, consulting, data processing and marine services to a broad business and consumer base throughout the world. The Communication Products unit designs, manufactures and markets products and systems that link a wide range of systems with integrated data network solutions. Our Insurance Systems unit provides software solutions to the general insurance industry. With our newly-formed Research and Consulting units, we are creating a competitive synergistic

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whole in the world market for voice, data transmission, private networks and systems integration.

Another key to recognizing our potential was the realization that we were *unique*. Teleglobe has a wealth of technical expertise, long-standing presence in international telecommunications consortiums and alliances, and a North American-based, highly-digitized, international network of cables and satellites that connects Canadians with over 220 countries — yet with only 2,500 employees worldwide we are not encumbered with the bureaucracy that often impedes rapid response and change.

With that in mind, we've introduced more new services in the past *four* years than in the previous *forty*. From virtual private networking — to *Globedirect's*™ direct interconnection, the range of services has multiplied to keep pace with the demand from our growing roster of clients. Teleglobe obtained the right to provide Canadian business customers with direct interconnection to the Teleglobe network — and in the process, saved them up to half of their international communications costs. We've doubled our sales force and introduced toll-free customer service numbers. Over half the Pacific transit traffic now passes through our state-of-the-art network. We've reduced our service implementation time by more than half. Teleglobe senior management and professional staff have gone out "on the road" and participated in four Client Listening Programs over the past year — and met with hundreds of

enthusiastic (*and rather surprised*!) customers. By listening to our customers in every way possible, we will ensure that our network and service development strategy continues to meet with their communications needs.

To ensure that we can continue to offer these services at competitive costs, we have further stepped up our bilateral negotiations with foreign carriers for substantial accounting rate reductions. On average, Teleglobe now offers Canadians some of the lowest rates in the world. And we will continue to respond to the changing needs of the Canadian consumer in the marketplace. We recognize and welcome the need to maintain a competitive telecommunications environment in Canada. One that means more jobs for Canadians, a more dynamic and innovative industry, and better and more affordable services for our customers.

Today's Teleglobe has a new strategic thrust — directed towards our customers, more than ever. We view our network as a platform to deliver services to these customers. We have complemented this technical infrastructure with a nation-wide (and international) service network of people and products. Corresponding changes in Teleglobe Canada's technical workforce have also reflected this customer oriented approach — to the point where there is no longer an engineering group that exists today as an entity unto itself. Project teams now respond to the needs of a variety of internal clients. The majority of our engineers have been redeployed to support the

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Sales, Marketing, and Operations functions. Interdisciplinary, cooperative workgroups in these three areas now work towards short-term, immediate response to the internal and external needs of Teleglobe and its customers. Solutions are developed quickly and their application is monitored and adjusted over time.

A most recent review of our internal structure has lead to the establishment of a *Strategic Development Group*. Teams of expert resources form Network Planning, Marketing Business Development, Government Relations, and International Affairs comprise this unit. Together, we are the strategic thinkers who will guide the long-term network expansion and business development strategy of Teleglobe Canada.

This group will drive the Research & Development that fuels our competitive service development activity and cost reduction drive. We support the corporation's Global Strategy to increase network service offerings and the capacity of our international network. We have also formed a new Research corporation and made a multi-million dollar, long-term commitment to consolidate all staff engaged in R&D activities. The new Research Center will focus mainly on evaluating technologies and standards with a view to developing new services and methods of cost reduction through the introduction of *new* technologies. At every level of the corporation (from interpersonal to international) we have rethought our structure

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and function along the lines of responding to clients and providing high-quality services — quickly.

We are increasing our overseas presence to get closer to our foreign customers and have recently opened offices in the UK and Singapore, with more in store for the future. We recognize that our customers require network flexibility and affordability, *end-to-end*. Our response is to build a Canadian infrastructure to better serve our customers and their needs. Our recent alliance with IBM Canada to increase our points of presence in cities across Canada and better serve our national business customers exemplifies this. It allows more Teleglobe customers to benefit from cost-effective, direct connection to our Network through our *Globedirect*™ family of services. From the overwhelming response we've received to this service introduction, this is what our *customers want*.

Teleglobe's mission statement sums up our strategy succinctly:

> Guided by efficiency, innovation and dedication to customer satisfaction, our mission is to be the world's leading provider of global telecommunications and information management solutions, while creating the value that allows our customers, partners, shareholders and employees to share in our future.

While the shift in Teleglobe's corporate culture has been significant over the past four years — change has become, and

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will continue to be, an integral part of our corporation's identity as we adapt successfully to the evolving needs of the competitive marketplace. The guiding question remains the same: *"Whose needs are we answering?"* We are proud to say that more and more often we respond to that question with: *"We are answering the needs of Teleglobe customers, partners, shareholders and employees"* — and we know we've found the keys to success.

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The case of Telecommunications

[illegible]
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* Paper presented at the Pacific Telecommunications Conference, January 1992, Sheraton Waikiki, Honolulu.
Comments on the draft of this paper by Dr. Tom Mandeville, are acknowledged with thanks.

Abstract

The rapid globalization of the information economy has emphasized new pressures for increasing the tradability of information services. Although the attributes of services and goods are clearly different there is no compelling case that the free trade paradigm and Heckscher-Ohlin pattern and direction of trade in goods is inapplicable to trade in services. On the contrary the principle of comparative advantage appears to be equally valid for services as for goods. Despite the absence of a theoretical rationale the advanced information economies have initiated GATT negotiations to establish a GATT type framework to regulate free trade in services such as telecommunications. There have been endorsed by self interest and apprehensions that non-tariff actions by developing economies might jeopardize the burgeoning free trade in services. Some countries have invoked the unconditional strategic trade theorem to protect high-tech sectors such as telecommunications under protection. But arguably the costs of rent seeking activities under such policies may be outweighed any benefits. Therefore, the normative prescriptions of the free trade paradigm still appear to be the best guide for policy formulation and institution building in international trade. The attempt to duplicate a GATT type regime for services is questionable when it is rudimentary because the advanced countries have subverted some of its cardinal principles. The rising sub-nationalistic hues at the core of the GATT free trade principles and has created a trilateral trading and telecommunications world. The theory of customs union postulates that regional trading blocs are second best. Regional trading blocs can be welfare raising if the major trading blocs opt for protectionist strategies and can be welfare enhancing if they pursue free trade strategies in telecommunications. The developing countries of the Pacific can reap vast benefits from modern telecommunications technology and there is no reason why that they will get further marginalized. However, the global welfare of free trade in telecommunications can only be realized if the policy makers in developed and developing economies can match their empty rhetoric on free trade to consistent policy actions. The GATT quest of free trade must pervade free trade in goods before it is duplicated to regulate trade in services such as telecommunications.

Keywords: Information economy. Negotiating free trade in Services. Telecommunications. Protectionism. Regional trading blocs. Asia-Pacific region. General Equilibrium Analysis.

1 Introduction – the globalisation of the information economy and the increasing tradability of services.

Most leading economies of the world are now information economies, where information related activities or the information sector generates the lion's share of national income and employment. The growing international trade in services is an indicator of the rapidity of the globalisation of the information economy. Developing economies are also rapidly restructuring, on occasion telescoping or leapfrogging the stagewise graduation process to become information economies (Juxxawalla et al., 1988).

At the epicentre of the globalisation of the information economy and the informatisation of national economies lies the revolutionary changes in information technologies. A cluster of microelectronic and optoelectronic technologies have profoundly changed the production, servicing and transmission processes that govern modern economic activity. The speed of electronically transmitted services have increased whilst the transactions costs have dropped dramatically. These developments have made services that were hitherto nontradeable into tradeable. The transnationalisation of production by multinationals corporations have stimulated the growth and diversification of trade in telecommunications services. The growth in intraindustry trade or trade in similar rather than different types of products is one indicator of the transnationalisation process. This in turn has contributed to the deregulation of the domestic and international telecommunication organisations. The domestic telecommunication monopolies had to abandon the natural monopolies based on the provision of universal basic telecommunications. Whilst international cartels such as the International Telecommunications Union (ITU) that monopolised international linkage and operation had to cope with increased competition. The ITU which had regarded telecommunications services as a nontradeable eventually abandoned its stance and complemented the General Agreement on Tariff and Trade(GATT) efforts to liberalise trade in services such as telecommunications. The globalisation of the information economy arguably is one of the important factors that made trade in services a central issue at the stalled multilateral trade negotiations (MTN) or the Uruguay Round (1986). The advanced information economies motivated by self interest established a parallel forum known as the Group of Negotiations on Services (GNS) to examine the feasibility of replicating a GATT type of regime to regulate the free trade in services such as telecommunications.

Trade in services occur when a resident or factor of one country receives a payment from a foreign counterpart. Trade in services covers both factor and nonfactor exchange of services. However, GATT since inception had steered clear of issues related to investment and factor movements. Under the aegis of the advanced information economies the GNS wanted to focus its attention on nonfactor services such as advertising, banking, financial, insurance, telecommunications, etcetera. However, developing countries that had a comparative advantage in labour intensive services such as construction wanted it on the GNS agenda. Curious anomalies surfaced when it came to the classification of services. For example, movement of personnel from advanced to developing is classified as services whilst the reverse process is defined as immigration (Nayyar, 1988: 40). The GNS agenda eventually included several new issues such as trade related investment measures (TRIMs) and trade related intellectual property rights (TRIPs). Many developing economies contended that the inclusion of new issues would distract GATT from making headway in the unfinished area of non tariff barriers reduction. However, proponents of GNS from advanced information economies eventually prevailed. It was argued that if GATT did not

address these new issues it would be forgotten in the dust of history (McCulloch, 1990: 334). In the GNS negotiations the telecommunications sector became a prime target of scrutiny and it was the first sector to be tested. The inordinate attention bestowed on the telecommunications sector at the GNS was undoubtedly due to the fact that it is one of the leading sectors of the emergent information economy. In fact, telecommunications is regarded as the electronic highway of the modern information economy (Robinson, et al., 1988).

The focus of this paper is on the issue of liberalising trade in services in the context of specifically freeing up trade in telecommunications. The analysis of trade in telecommunications services highlights the large gap that exists between the rhetoric of the advocates of free trade in services and their protectionist practices. The paper is organised as follows: Section 2 examines whether there is a theoretical basis for duplicating a GATT like regime specifically to regulate services such as telecommunications. Section 3 highlights that despite the free trade rhetoric on services at international fora, leading proponents resort to mercantilist domestic policies when self interest is at stake. Section 4 reviews the tenets of strategic trade theories which attempts to lend an air of respectability to protectionist policies for high-tech sectors such as telecommunications in developing economies. Section 5, examines the emergence of regional trading and telecommunication blocs from the perspective of customs union theory. The increasing competition between the blocs and their welfare effects are reviewed. Section 6 focuses briefly on the predicament of the developing Pacific nations. They could either benefit or get further marginalised by the development of telecommunications. Section 7 attempts to modify estimates of general equilibrium welfare effects consequent upon major regional blocs opting for free trade or protectionist strategies for trade in services. Finally, section 8 presents some concluding comments.

2. The theoretical rationale for a separate regime for trade in services.

Goods and services have different attributes. However, that by itself does not provide a justification for establishing a separate framework to regulate the free trade in services. In this section issues relating to characteristics of services and whether neo-classical trade theory and the principle of comparative advantage is tenable for trade in services just as it is for goods will be reviewed. The different attributes between goods and services were noted as intangibility, nonstorability or nonstockability, inapporopriability, nontransparency (Hill, 1977). Furthermore, it was noted that both the consumer and producer must interact for the rendering a service. The distinction between goods and services, however, remains fuzzy under the impact of modern technology. For example, the services of a tenor such as Pavarotti is converted into good when it is recorded on a compact disc or cassette (Bhgawati, 1984). Furthermore, services through telecommunications can be recorded and retrieved. Non-marketed intrafirm services with specialisation become marketed. Therefore, given that goods and services change character and can be splintered or disembodied from one another any regulatory system that attempts to separate trade in goods and services would be unnecessarily buying into a maze of definitional problems.

Based on the Ricardian notion that factor mobility is a prerequisite to render services recent taxonomies (Stern and Hokeman, 1988; Sampson and Snape, 1985) identify at least four broad types of services :(i)Both producer and consumer are immobile when the

service is transmitted (e.g. architects drawings to an engineer abroad). (ii) Only producer is mobile and has to render services at a location where consumer is immobile (e.g. Korean construction firm moving to build in Saudi Arabia). (iii) Only the consumer is mobile and has to go to the producers' location to consume the service (Japanese tourist visiting Hawaii to enjoy the pleasures of a tropical island). (iv) Both producer and consumer are footloose and can trade in services in any nominated location. The principle of comparative advantage is deemed to be tenable for the various types except, perhaps for type (iii) service where exporting factors can shrink the production possibility curve of the exporting country and shift it out in the importing country undermining comparative advantage. This happens because the autarkic price of the factor for the exporting country exceeds that of the importing country (Deardoff, 1985:53–68). However, even when the principle of comparative advantage is violated trading is positive sum game that enhances the welfare of the participants (Jones, 1985). The whole gamut of neo–classical factor endowments theory or the Heckscher–Ohlin model seems to be applicable with equal vigour to trade in services as it is for trade in goods (Hindley and Smith, 1984). The fundamental theorems such as the Samuelson factor price equalisation theorem also seems to be tenable in the case of services (Bhagwati, 1984). Trade theory does not provide a persuasive rationale to treat trade in services any differently from trade in goods despite the fact they have different attributes.

The classification of services has also been made on the basis of the cost of interaction between consumer and producer of service, defined as the simultaneity factor (Hirsch, 1989). The simultaneity factor assumes values near the upper limit of unity for services that require high interaction costs of the consumer with the producer, whilst for traded goods the simultaneity factor may be near the lower limit zero as the required interaction is negligible. The revolution of information technology has reduced the transactions costs and increased the interaction between service producers and consumers internationally. In other words it has increased the tradability of services.

The revolution in information technology has increased the tradability of services through telecommunications. Rent seeking developing economies are poised to milk some of these rents by instituting mercantilist polices. The advanced information economies and their multinational corporations do not wish to witness the undermining of the free trade in services. Although there is no persuasive theoretical basis for establishing a separate GATT like regulatory framework for services the advanced countries have flexed their muscle and put the issue of service negotiations firmly on the GATT agenda. However, without making the GATT regime on goods function true to its free trade charter the duplication of another flawed institution to cover free trade in services appears to be questionable.

3. Free trade in rhetoric but protectionist in policy actions.

The neo–classical free trade paradigm provides a clear message that free international trade based on perfectly competitive markets maximises national income of the participants and thereby global welfare. Free trade is the first best optimum and its spirit is enshrined in the GATT principles and upheld by all its members at least in their public pronouncements, although not in their policies. This may be due to the fact that although the powerful normative superiority of free trade may win the arguments on international

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trade it may not win the votes at home (Yeager and Tuerk, 1976). The lengthy deliberations on telecommunications in GNS is a case in point on the schizophrenic behaviour of both advanced and developing economies. They are overtly free trade in their rhetoric in international fora but are covertly protectionist when their self interest or rent earnings are threatened.

The lengthy GNS deliberations on telecommunications did not advance beyond the acceptance of the same principles of free trade enshrined in the GATT charter on goods. Basically, GATT principles are committed to free trade in a competitive market environment and therefore aims at removal of trade barriers that distort gains from trade (Feketekuty, 1988). A review of the principles agreed for free trade in the telecommunications sector show that they are the same old GATT principles with a new GNS label and they are: (i) Non-discrimination or the Most-Favoured-Nation (MFN) principle whereby all trading partners are accorded the same treatment. (ii) Transparency or making the customs duties and non tariff barriers to trade clear to prospective competitors.(iii) Equal treatment whereby foreign and domestic firms are treated equally by host governments. (iv). Developing countries were also afforded progressive liberalisation or market access commensurate with their level of development thereby affording them non reciprocity. (v) The rights of establishment or enabling the foreign firms to perform their business operations through local branch offices in the host country.

However, when the first principle relating to non-discrimination or MFN provisions was put into practice the most vocal advocates of liberalisation of telecommunications have sought to undermine it. The USA and its national lobbies such as AT&T successfully sought to exempt basic telecommunications from free trade coverage on the grounds that it would enable foreign competitors to free ride without offering any reciprocal benefits. However, when it comes to non-basic or value added services the USA and its giant telecommunications multinationals have enthusiastically supported liberalisation. Ironically these multinationals enjoy a decisive technological lead and are poised to free ride in the telecommunication sectors of other countries and make massive profits. The double standards applied to liberalising non-basic services whilst protecting basic telecommunications services exemplifies once again the truth in the allegation that 'free trade when you are strong and mercantilism when you are weak' has been the hall mark of the recent GATT negotiations on telecommunications services. Despite, the free trade rhetoric on services similar mercantilist behaviour was evident in relation to other sectors. For example, USA was reluctant to liberalise trade in aviation and shipping, caving into pressure from domestic lobbies.

The developing economies have also sought to undermine the demands for free network access or market access to domestic telecommunications market by unbundling the mode of delivery from the network access issue. They hope, thereby to secure a bargaining chip in subsequent rounds of GNS negotiations. Furthermore, developing countries, based on promptings of the ITU, would like to tradeoff market access for infrastructure development in the vital telecommunications sector. The apprehensions of developing countries on the open door policy to telecommunications trade is not without some justification. First, developing economies fear that a free market in telecommunications services and equipment will toll the death knell of their nascent domestic telecommunications sector. Second, they contend that technological and cultural

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imperialism and further marginalisation of their telecommunications sector would result because of predatory competition by foreign multinationals. Third, they fear the loss of economic control over vital strategic sectors such as telecommunications, banking and finance, shipping and aviation. They consider that such erosion of control over key service sectors will pose a threat to their national security and sovereignty. However, developing economies despite their defiant and protectionist posturing have often toed the line when threatened with trade sanctions and other retaliatory measures by the advanced countries.

A major stumbling block in the progress of GNS at the beginning was the stubborn stance taken by the International Telecommunications Union (ITU) which regarded telecommunications to be a nontradeable service. Partly, this was a legacy of the ITU as the supranational cartel that regulated the international trade in telecommunications during the moribund industrial era by its monopoly over technical standard setting, tarrification, accounting. The ITU cartel operation enabled the reaping of monopoly profits from the provision of vital services that ensured the international interconnectivity and interoperability of domestic telecommunications monopolies. However, multinational corporations in their push for internationalisation of production demanded independent network access for enhanced service. Telecommunications was crucial to a multinational firms efficient performance in the competitive international trade arena. The ITU was exposed as a rent seeking cartel which manipulated tariffs and accounting. It was also alleged that it failed to deliver as the official custodian of infrastructure development in developing countries. Under pressure and virtual blackmail the ITU has softened its uncompromising stance to become a partner with GATT. It now acts to complement and support the GATT negotiations to establish a free trade regime for services (ITU, 1991).

The progress on multilateral lateral trade negotiations at the Uruguay Round (1986) has been mainly thwarted by the intransigence of the advanced countries to reduce agricultural subsidies. With respect to GNS there is disarray and " the developed rather than the developing economies– which always espouse trade liberalisation but are sometimes driven more by mercantilist and protectionist impulses" (Woodrow,1991:341) are responsible for it. This is because their free trade rhetoric does not translate into policy actions.

4. The case of promoting telecommunications as a strategic trade sector.

The protectionist arguments for government intervention in high–tech sectors such as the tradeable telecommunications services has recently received some academic respectability from the so called new trade theories. The new trade theories incorporate market imperfections, such as economies of scale, product differentiation, game theory, and organisational strategies. These new theories purport to explain why strategic sectors can maximise national welfare if promoted by government intervention by granting tariff and non tariff protection. The new theories have explained the empirical puzzle why much of the world's trade amongst advanced countries is increasingly intra–industry or in similar goods and services rather than in dissimilar ones as explained by the neo–classical theory of comparative advantage. Return to scale internal to the firm and product differentiation become crucial in explaining the genesis of intra–industry trade. Here, the type of firm is invariably a multinational corporation and telecommunications play a vital role in both internal and international management of the firms production and trading operations.

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Many government's therefore identify high-tech production and service sectors such as telecommunications as winners on strategic grounds for special protectionist treatment. It is generally argued that they generate positive externalities and R&D on them will not occur at the required level because of inappropriability problems (Hindley and Smith,1984). These are grounds that new theories invoke to justify protection for high-tech sectors such as telecommunications (Grossman and Shapiro,1985).

It is possible to use game theoretic pay-off matrices to demonstrate that government's can shift rents and make the domestic telecommunications sector gain at the expense of potential foreign rivals (Brander and Spencer, 1981). However, in practice such interventionist policies opens up a Pandora's box of uncertainties. First, the various game theoretic outcomes from the behaviour of rival interactions are very difficult to quantify. Therefore, policy formulation to implement strategic trade theory becomes a formidable task and a risky business (Grossman and Richardson, 1985). Second, even when strategic trade policies are implemented they could attract foreign telecommunications firms to domestic markets. Then the government would be unwittingly subsidising the foreign competitor rather than the local firm, thus undermining the whole rationale of rent shifting (Dixit, 1984; Hortsmann and Makusen, 1986). Thirdly, the general equilibrium arguments militates against the strategic promotion of telecommunications sector as this would shift resources away from other domestic sectors. Cost rises would make other competitive sectors in the economy uncompetitive. The losses from adverse effects on other sectors may far outweigh the benefits from the promoted domestic sector thereby resulting in a large overall macroeconomic loss of welfare. Fourthly, the introduction of domestic distortions to generate national welfare benefits welfare at the expense of world welfare are beggar thy neighbour type policies that can lead to retaliatory actions. These deficiencies make strategic trade polices loose some their appeal.

Some analysts contend that there is nothing new about strategic trade arguments. They are allegedly the old wine of the infant industry argument in a new bottle. The infant industry argument has an economic basis if according to the Mill-Bastable theorem, the net discounted value of an interventionist action turns out to be positive. However, the finely researched findings of the political economy of protection militates against giving of protection even on a temporary basis as it has a tendency to outlive its usefulness. The political economy of protection highlights the inefficiencies associated with rent seeking behaviour (Krueger, 1977) and directly unproductive activities of protectionist lobbies (Bhagwati,1982). In retrospect even the architects of strategic trade theory acknowledge the allocative inefficiencies, administrative costs, and the dangers of retaliation by rivals and recant their support for strategic intervention (Krugman,1987). Therefore, after careful analysis of the inefficiencies inherent in strategic trade theory we concur that free trade is not passe after all (Bhagawati, 1989). It remains the dominant paradigm for distilling policy guidelines for international trade in telecommunications and other services.

5. The emergence of trilateral regional trade and telecommunications blocs.

The violation of the basic tenets of the free trade principles enshrined in GATT articles of non-discrimination or MFN clause, and tariff only restrictions are evident in the USA Super 301 laws, the voluntary export restraints (VER) on textile, car and other imports. One of the most flagrant violation of GATT principles is the French non tariff barriers on

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Japanese video cassette recorders (VCRs) known as the Poitier's syndrome. The French reduced Japanese VCR imports to a trickle by subjecting them to delaying customs checks in a remote border post called Poitier. The rising tide of neoprotectionism has led to the emergence of a trilateral trading world centred around North America, Europe and by default the Asia-Pacific Region. The close symbiotic relation that exists between trade and telecommunications has been analysed empirically (Karunaratne, 1988). It is manifest, in the configuration of telecommunications to three separate blocs corresponding to the three trade blocs: North American Free Trade Area (NAFTA), Single European Common Market (SECM) and the residual Asia-Pacific Trading Area (APTA). The leading information economies in the telecommunications blocs are engaged in fierce competition to become switching nodes for leased lines or regional hubs. England is the current hub for Europe and Hong Kong is the hub for Asia-Pacific region. But, Ireland in Europe, Singapore and Australia in the Asia-Pacific region are increasingly competing to becoming regional hubs (Langdale, 1988).

The theory of economic integration or customs union theory enunciated by Viner (1950) and refined by Lipsey and Lancaster (1957) clarifies that formation of regional trading or telecommunications blocs are a special case of the theory of the second best. This implies that regional blocs whilst they liberalise trade between partners in the bloc may be welfare enhancing only if the trade creation effects exceed the trade diversion effects. Vinerian theory defines trade creation as the increase in welfare due to extra consumption arising from cheaper imports from a bloc partner. Whilst trade diversion is the welfare loss due to higher cost imports from a partner. The fact that regional blocs can be welfare reducing make them second best as a move towards freer trade is not necessarily Pareto optimal. There is no reason why the logic of Vinerian integration theory is not applicable to trade in telecommunication services. In fact, the formation of NAFTA and SECM are expected to result in massive welfare increases because trade in services are anticipated to increase within the regional trading blocs (Globerman and Booth, 1989; Stehmann,1991). Much of the increase in intra-regional trade is anticipated to be generated from the expansion of value-added network services or VANS. However, the welfare improvements in regional trading and telecommunications blocs are at the expense of the rest of the world as they have beggar-thy-neighbour effects. Some features of the North American and European regional telecommunications blocs are reviewed next.

The NAFTA or Free Trade between USA and Canada has witnessed a significant liberalising of telecommunications trade between the two countries. The achievements of NAFTA on regional telecommunications provides a way out of the tardy global liberalisation efforts of telecommunications under GNS. However, the theory of customs union warns that regional liberalisation in telecommunications trade could be second best. Also from a global perspective it is welfare reducing because it is at the expense of the other telecommunication blocs. Nevertheless, significant breakthroughs on transborder US-Canada telecommunications trade have been achieved under NAFTA:(i) The right of establishment to compete in the area of non basic value added network services;(ii) the reduction of tariffs; the relaxing of non-tariff barriers or requirements on technical standards; (iii) improved transparency in regulation of telecommunications trade; (iv) streamlined bilateral dispute settlement mechanisms; (v) elimination of restrictions on direct investment and lifting impediments to the movement of business personnel. The NAFTA agreement dodged the thorny transportation and culturally sensitive trade issues.

The proposed Single European Common Market (SECM) in 1992 would integrate telecommunications networks and aid free transborder flows of telecommunications in the Common Market. The architects of SECM realise that telecommunications is not merely a service but a vital resource that can be harnessed for economic integration by facilitating macroeconomic coordination and microeconomic harmonisation. Telecommunications services plays a critical role like a single currency unit, free factor mobility, in integrating and making SECM a reality. Therefore, the Commission for European Communities (CEC) has invoked the competitive provisions of the Treaty of Rome, article 90, to end or vary domestic monopolies on terminal equipment , government procurement and technical specifications on services. The net trade creation effects emanating from an integrated telecommunications market among members of a community closely bound by economic and cultural ties are anticipated to be spectacular in the near future. However, the contemporary environment in Europe remains fractured by competition and regulation (Mansell et al.,1989:64) but there are inexorable political forces that will hasten the integration of European telecommunication markets in the long run.

6. The Asia Pacific Region & the developing Pacific Island Nations (PINs)

The increasing competition amongst partners in each regional telecommunications bloc is manifest in the arena of fibre optic and satellite facilities construction. In the Asia–Pacific Region the submarine coaxial networks are being duplicated by new fibre optic cables linking up the other regional blocs. Furthermore, Cable and Wireless in implementing their strategy of establishing a global digital network is linking up the ASEAN countries, Pacific Island Nations (PINs) and the other regional blocs and investing in manner that will deter rivals as foreshadowed in strategic trade theory. Also several new satellites are anticipated to compete with INTELSAT. The net result is anticipated to be massive excess capacity and fall in prices particularly in the Asia–Pacific Region. However, even in the Asia–Pacific region the major beneficiaries from the telecommunications development bonanza are likely to be the richer countries that include the four dragons (Singapore, Taiwan, South Korea and Hong Kong). Australia and New Zealand have already embarked on a closer economic relationship agreement (CER) and there are larger benefits possible from integrating into a single market (Lloyd, 1991).

However, the PINs scattered over 29 million square kilometres of the Pacific Ocean could miss out from the benefits of competition in telecommunications in the Asia–Pacific region. The dispersed nature make them suitable for footprinting by satellites. However, the PINs are on the thin route telecommunication locus and do not offer multinationals the prospect of cream skimming. The economic disparities that exist between PINs is reflected in the teledensity disparities (telephones per 100 population) which is 1.5 for Papua New Guinea compared to 67 for New Zealand. The rural urban disparities within PINs are also large (Jussawalla and Ogden, 1989). The double dualism that prevails in developing PINs has been censured on humanitarian and common interest grounds (Maitland, 1985). The radical perspective contends that infusion of high–tech such as telecommunications can further marginalise PINs economically and culturally. On the positive side, theoretical analyses shows that the integration of PINs into a regional bloc would improve their welfare due to the presence of multinationals and their job creation effects (Beladi and Samanta,1991).

7. Welfare scenarios for services due to pursuit of free trade versus protectionist strategies.

The emergence of a trilateral regional trading and telecommunications blocs are certainly second best as they do not maximise world welfare and further one region's gain could be at the expense of another bloc. However, in the area of trade in services all the trading and telecommunications blocs are poised to grow in a symbiotic fashion with the rapid globalisation of the information economy. Below, we make use of the estimate of the CIE (1990) computer general equilibrium (CGE) model calculations to map out the welfare scenarios due to the pursuit of different strategies by the major regional blocs. The estimates are only ball park figures for services based on the heroic assumption that trade in services comprise 30% of the value of total merchandise trade, as reported in GATT statistics. The welfare implications **per se** for telecommunications services cannot be estimated as published data on electronic trade in information services is not available.

The Pay-off Matrix for welfare effects of trade in services (Table 1) is estimated on the basis of a protectionist strategy and free trade strategy for North American region and the European region. The GDP changes due to the pursuit of the alternative strategies on other regions are quantified in the pay-off matrix. If both North America and European regional blocs on a protectionist strategy we have in cell I the estimates for the worse case scenario with global trade in services shrinking and decreasing world GDP by $US61 billion. Europe would be the worst affected, Asia-Pacific would account for an 8% share of the global reduction in GDP. If Europe opts for a free trade strategy whilst North America keeps the trade shutters on services world welfare will increase by $US 40 billion and Asia-Pacific will benefit as much as other regional blocs as shown in cell II. If Europe opts for fortress strategy whilst North America goes free trade on services, welfare increase would be only $US 15 billion and the Asia-Pacific gains are as much as the North American welfare gains as indicated in cell III. The best welfare scenario eventuates when both North America and Europe goes free trade on services. The welfare effect on the world is shown in cell IV, by the increase of GDP of $US 119 billion. Europe is the largest beneficiary from the best case scenario, accounting for nearly 4 times the welfare gains of the Asia-Pacific region. The difference in welfare gains from pursuing extreme worse case or protectionist and the best case or free trade strategies for services by the major regional blocs is about $US 180 billion (i.e. cell IV minus cell I). Also other calculations indicate that if Asia-Pacific decides to unilaterally liberalise its trade in services it could gain $US 67 billion with Japan being the major beneficiary (Banks and Stoeckel,1990).

Table 1. **Payoff Matrix for Trade in Services Protectionist Vs. Free Trade Scenarios Percentage ($US billion)**

North American / European		Protectionist		Free Trade	
		Cell I		Cell II	
Protectionist	Europe	-61%	(-37)	32%	(13)
	Asia Pacific	-8%	(-5)	28%	(11)
	North America	-31%	(-19)	40%	(16)
	World	-100%	(-61)	100%	(40)
		Cell III		Cell IV	
Free Trade	Europe	74%	(11)	53%	(63)
	Asia-Pacific	13%	(7)	16%	(19)
	North America	13%	(7)	31%	(37)
	World	100%	(15)	100%	(119)

Source: CIE (1990) General Equilibrium Model Calculations.

8. Concluding remarks.

The international trade paradigm and associated principles of comparative advantage appears to be equally applicable to both goods and services such as telecommunications, although they share different characteristics. Therefore, there is no theoretical grounds for asserting that policy making or institution building for regulating the free trade in services should be different from free trade in goods. Therefore, it is quite pertinent to question all the fuss about negotiating for a free trade regime for services (Voigt,1991).

The fact that the principal architects of GATT have flagrantly violated the cardinal free trade principles enshrined in Article 1 by non-tariff barriers needs to be rectified before a similar flawed system is duplicated for services. The replication of a malfunctioning systems does not augur well for free trade in services. It may only distract GATT from the task of counteracting the non-tariff barriers that is gnawing at its very existence as free trade custodian of the world. Non-tariff barriers on goods are so adverse in their welfare impact and opaque when instituted. But the insidious effects and nontransparency problems with regard to services are likely to be more complex and unless the practioners of neoprotecionism eschew them and act according to GATT free trade principles having a separate GATT like regime for services will not ensure free trade in services. Therefore, the fundamental problem that appears to threaten the world trade system is the spread of non-tariff barriers in goods and services or neo-protectionism. This has to be tackled head on by spokesman for both advanced information economies and developing economies by matching their public rhetoric on free trade with concrete policy action at home.

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COMPETITION IN AUSTRALIA

A WINNER'S PERSPECTIVE

INTRODUCTION AND SUMMARY

On November 19th , 1991, a consortium named Optus Communications was announced as the winner of the competitive bid to purchase AUSSAT, Australia's domestic satellite carrier, together with a second carrier licence.
This paper describes the background to the unique bidding process, the regulatory environment adopted by the Australian Government and the strategies employed by Optus to present the winning bid. It further describes how, having won the licence, Optus intends to build and develop its network and services and rapidly provide the benefits of competition to the Australian public.

BACKGROUND

On November 12th 1990 the Minister for Transport and Communications, the Honourable Kim Beazley M.P. published a document entitled " Micro-Economic Reform: Progress Telecommunications". This document recorded the decisions made by the Government to introduce full network competition to Australia. The most significant steps in the process are as follows:

- the establishment by the end of 1991 of a private sector competitor to a merged Telecom/OTC in the provision of network facilities,
- the introduction as soon as practicable during 1991 of competition in the provision of services through introduction of full resale of domestic and international telecommunications capacity. In other words the current distinction between value added services and reserved services will be eliminated,
- three Public Mobile Telephone Services licences will be issued, including one to AUSSAT prior to its sale and one to Telecom/OTC. Telecom's MobileNet will be required to sell air-time on its existing analogue system to other PMTS licencees,
- the provision of Public Access Cordless Telephone Services (PACTS) will be opened to full competition in accordance with the recent AUSTEL recommendations,
- the issue of further mobile PMTS licences will be considered in 1995, and
- the duopoly will be reviewed on 30th June 1997.

The mechanisms adopted to achieve this process were revolutionary and wide ranging. It is clear that the Government had learned from the competitive experiences in the USA, UK and Japan. It was determined that where competition had been slow or incomplete, that the impediments causing those deficiencies would be removed. In achieving this, the Australian Government had the clear advantage of being the outright owner of the incumbent monopoly carriers, Telecom Australia and OTC.

The principal strategies proposed to encourage the rapid establishment of effective competition were as follows:

- Telecom would be required to provide interconnection for the second carrier on an equal access basis, **at directly attributable incremental cost.**
- Telecom would be required to share ducts, radio sites and other facilities where practicable,
- Telecom would be required to originate, carry and complete calls on behalf of the second carrier,
- Telecom would be required to provide full access to information about traffic carried on the network,
- International access will be equally available to both carriers

The regulatory body AUSTEL was charged with overseeing the detailed implementation of these arrangements. Its major functions were defined as: technical regulation; promotion of fair and efficient market conduct; protection of customers and industry policy objectives.

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Optus Communications

The other major announcements in the paper were the proposed merger of Telecom Australia and OTC to form a single entity to be known as Australian Overseas Telecommunications Corporation (AOTC) and the arrangements for the sale of AUSSAT, Australia's domestic satellite carrier.

Overall, the paper set the stage for the most rapid and widespread introduction of competition in telecommunications ever attempted in an OECD country. A great deal of detailed work was needed to put these strategies into legislation and operation, but they have survived substantially intact and their effects will shortly be visible in the Australian telecommunications market.

FORMATION OF THE OPTUS CONSORTIUM

Within days of Minister Beazley publishing his paper, both BellSouth and Cable and Wireless were independently evaluating the opportunity. Cable and Wireless, as part of its global marketing strategy, maintained a small business office in Australia, while BellSouth had a significant interest, having acquired the largest paging company in Australia, Link Communications.

Both companies already had interests in the region. Cable and Wireless had been involved in bidding for Telecom New Zealand, which was sold in 1990 to a consortium of Bell Atlantic and Ameritech. BellSouth were preparing for cellular operations in New Zealand, in addition to their Australina operations.

Given the magnitude of the Australian opportunity, which encompassed domestic wireline communications, cellular and international, it made sense for the two companies to get together and letters of intent were exchanged in December 1990 between BellSouth and Cable and Wireless.

The Australian Government was prepared to wait, as was New Zealand, five years before requiring majority Australian ownership of the second carrier licensee. However, both BellSouth and Cable and Wireless believed that a consortium which was Australian owned from the outset would have a greater chance of success.

In March and April 1991, after much 'behind the scenes' negotiation and discussion a tentative consortium came together consisting initially of :

• BellSouth	24.5%
• Cable and Wireless	24.5%
• Mayne Nickless	20%
• AMP Society	10%
• NMP	10%
• AIDC	10%

The Australian partners have since formed a holding company, Optus Pty Ltd. which now owns 51% of Optus Communications.

BellSouth and Cable and Wireless as the 'telecommunications partners' were to be responsible for the building of the network and the initial marketing of services while the Australian partners provided valuable input in the areas of industrial relations, industry policy and of course lobbying.

DEFINING A STRATEGY

The first major task facing the telecommunications partners of the newly formed and 'yet to be formalised' consortium was the development of an overall strategy and an accompanying business case. On the major strategic assumptions, BellSouth and Cable and Wireless were remarkably close together from the outset.

The first and obvious priority was to develop a strategy which would win the licence and the right to purchase AUSSAT. To achieve this, it was obviously necessary to pay close attention to the Government's priorities, which as they stated in numerous publications were listed as:

- rapid development of network based competition and the offering of competing services to a broad spectrum of Australian consumers,
- development of an industry policy showing tangible benefits to Australian manufacturing and exports,

- Australian participation and the creation of new jobs.

The actual bid price for AUSSAT was consistently downplayed by the Government as being of relative unimportance. However, since it had been announced that AUSSAT would be sold debt free, which meant the Government picking up between A$700-$800 Million, there would clearly be political pressure to recover as much as possible from the sale of AUSSAT.

With these priorities in mind, the consortium agreed on the following major assumptions to be tested in the business case:

- that Optus would be a facilities based full service carrier and would make use of AOTC infrastructure only in the early stages of its development. Optus would not be a reseller in the long term.
- that Optus would not provide services until it could do so with its own billing systems as a minimum.
- that Optus would build its network as rapidly as technically feasible given the economic and geographical constraints imposed by the Australian market.
- that Optus would form strategic alliances with major equipment vendors to assist in developing an industry policy attractive to the Government and ensuring the rapid delivery of vital infrastructure after the licence award

Developing an agreed business case was a lengthy exercise, of which perhaps the most interesting and contentious issue was the prediction of market share.

In both the UK and the USA, the growth of market share by minority carriers had been relatively slow, impeded by interconnect regulations which had evolved rather than been imposed. In Japan, where competition had been introduced in international services with equal access, the growth of market share had been explosive.

Determining a realistic formula for market penetration in the Australian environment under the 'not quite equal' interim access conditions proposed, was a major undertaking. Too little share would result in a non-viable business case, too much would overwhelm a network in its embryonic stages of development. With little relevant experience world-wide, this problem remains the biggest unknown that Optus faces. However, when its initial network is built, the upper limits will be set for the short term.

(It is interesting to note that long after the Optus business case was developed, AUSSAT launched its own international telephone service across the Tasman Sea to New Zealand. Service commenced in July 1991, serving the Sydney market only. In December AUSSAT reported that it had gained approximately 15% of the available market using the alternate access code 0099 in place of the OTC code 0011.)

Technical decisions which were built into the business case were as follows:-

- Subscriber/Tandem switches would be installed in Canberra and the five major state capitals by the middle of 1993,
- Inter-city fibre optic links would be built using 2.5Gbit SDH technology to extend from Brisbane to Perth by 1997,
- Fibre optic rings would be built in the central business districts of the major state capitals and Canberra to enable direct connection and centrex services to major business customers,
- A GSM cellular network would be built to cover 80% of the population by 1997
- Intelsat earth stations would be built to enable access to both the IOR and POR satellites by the fourth quarter of 1992
- An international gateway switch would be installed in Sydney by the fourth quarter of 1992,
- To establish a customer base and early visibility for Optus, the air-time resale of Telecom's AMPS cellular service would commence in mid-1992,

- To commence the development of integrated operational support systems with the aim of, not only providing Optus with the ability to compete effectively, but of building a potentially valuable export product.

RESPONSE TO THE "REQUEST FOR PROPOSAL"

The Government had called for detailed proposals from those parties intending to bid for the purchase of AUSSAT to be submitted by July 15th. At the time, no official information was available on the number of interested parties. A reported total of 25 companies had filed an expression of interest, but it became increasingly clear that only two consortia were seriously pursuing the opportunity.

Optus made a decision to disclose its plans in considerable detail to the Government in its response and submitted a substantial document with heavy emphasis on its industry policy, supported by the strategic vendors which had been selected for its major infrastructure.

The proposals were treated in strict confidence so nothing is known of the relative merits of those submitted, but the outcome was that two consortia submitted proposals and two consortia were 'short listed': Optus and the Kalori consortium consisting of Bell Atlantic, Ameritech and Hutchison Telecom.

PLANNING AND CAMPAIGNING

The Government announced that it would be holding to its original timetable and that the short-listed contenders would be required to submit their final tenders for the purchase of AUSSAT by the end of October.

In the meantime, a two month period was allowed for the individual negotiation of a detailed interconnect agreement between both contenders and AOTC. The negotiations were intended to be bilateral, allowing for different agreements with each contender and were to be commercially based. Recognising the difficulties of interpreting the original Government offer of interconnect at 'directly attributable incremental cost' , Austel was charged with producing the initial charges for basic interconnect which are discussed in more detail in another section of this paper.

There were a number of important tasks to be accomplished in the period between submitting responses to the RFP and the final tender. Among these the most important were:

- The development of Optus' industry policy to the point where tangible and irrevocable commitments could be made.

- Monitoring and providing input to the new Telecommunications Act which had to be passed by the Commonwealth Government before the sale of AUSSAT could proceed.

- The negotiation of a draft licence.

- The negotiation of a sales contract acceptable to both Optus and the Government.

- The due diligence process, not only on AUSSAT which was being purchased, but in lesser detail on Telecom and OTC who held all the necessary information for sizing and valuing the existing market.

Optus established three teams for this period of the bidding process. A commercial team responsible for interconnect, and negotiations on the sale agreement and licence. A Public Relations team responsible for all lobbying and PR activities and the largest groupt of all tasked with Implementation Planning.

Because Optus had promised a rapid roll-out of its services and infrastructure in its RFP response, it was clear that the initial engineering, marketing and planning work could not wait for the award of a licence.

The implementation planning team therefore continued to work on developing detailed specifications, designs and marketing plans on the assumption that the licence would be awarded to Optus. There were obvioulsy additional benefits from this work in support of the commercial team and in the continual refining of the business case which would ultimately determine what Optus could afford to offer for AUSSAT.

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The result of this not inconsiderable effort was that , by the time the award was announced on November 19th, Optus had almost completely specified and agreed configurations and deliveries with major vendors, it had undertaken detailed studies of probable routes for its fibre optic links and was well advanced in the procurement of interim support systems and the planning of its GSM network configuration.

INTERCONNECT

In April 1991, Austel published progress and interim reports on the technical and operational framework and the arrangements and charges for interconnect. These were intended as discussion documents and generated widespread comment from Telecom, OTC and other interested industry participants including, of course, the then potential bidders for the second licence.

In June, Austel published confidentially its proposed usage charges for interconnection. The press release accompanying this determination referred to an average single ended charge in Metropolitan areas of A$3.14 cents per minute.

Given that untimed local calls in Australia cost A$0.24, allowing resellers an effective interconnect rate of about A$5.3 cents (based on a 4.5 minute call) payable only on effective calls, this determination is not particularly favourable to the second carrier. However it fell within the range of Optus' expectations.

The detailed interconnect arrangements negotiated with Telecom and OTC during September and October are still covered by confidentiality agreements and cannot be disclosed. Optus was able to draw upon the experience of Mercury in the UK, which, combined with well known precedents in the USA and Japan, made possible the negotiation of a satisfactory interconnect agreement in what must be a world record time.

For the benefit of those not familiar with the Australian interconnect environment the following are its major features:

- subscriber access from the AOTC network, prior to the implementation of full equal access, requires a single digit access code. For example instead of 03 nnn nnnn to dial Melbourne from Sydney, a subscriber choosing Optus will dial 103 nnn nnnn.
- Optus has the right to use capacity leased from AOTC to connect customers to its network, to connect Optus facilities to AOTC points of interconnect or to connect nodes on the Optus network.
- AOTC will supply CLI (calling line identification) to the Optus network when calls are handed over.
- AOTC will provide BNA (billing name and address) to Optus so that Optus may bill its customers directly from the CLI data.
- AOTC will prepare for equal access based on pre-selection and must be in a position to provide it on 100% of its customer lines by 1997. The method, and precise date of implementing equal access has not yet been determined.

Initially these arrangements are applicable only where AOTC has the technical capability of providing the necessary facilities. CLI is available at present only from about 69% of the Telecom network, but AOTC is committed to provide it on 100% of their exchange lines by 1997

THE OPPOSITION CRUMBLES

Having proudly announced the addition of France Telecom to its consortium in early October, a move that seemed to Optus necessary in view of its lack of international operating experience, Kalori announced later in the month that Bell Atlantic, Ameritech and France Telecom were pulling out, leaving Hutchison Telecom to continue alone.

This announcement, though preceded by the usual flood of rumours, came as a surprise to all concerned. Optus viewed the development with mixed feelings since, while it welcomed the 'downsizing' of its opposition, there seemed to be a real risk that, if all competition evaporated, the Government might be forced to rethink its entire plan.

In the event, Hutchison Telecom confirmed their intention to continue alone, with the addition of AT&T as a strategic vendor and presumably adviser and they left open the option for Telecom New Zealand to take equity in the consortium after a licence was awarded.

THE RESULT

Optus submitted its bid on November 12th. Given the length of the bidding process and the complex and detailed negotiations necessary, the final submission date was remarkably close to the Government's originally announced deadline.

By this time most media commentators were confidently predicting an Optus win and Optus confidence was high. However, Hutchison Telecom remained a serious contender with substantial resources and it was therefore with feelings of great relief that the press release was received from Minister Beazley's office on the afternoon of November 19th, announcing the award to Optus.

The reasons why Optus was selected will never be fully revealed, and perceptions are so often more important than facts, so perhaps some extracts from an article by one of Sydney's better informed journalists will have to suffice:

"If prizes are to be handed out for the most professional lobbying exercise of the year, Optus Communications would win hands down..."

"...a race Optus won in a trot, having burned its opposition with a very professional combination of lobbying, marketing and public relations backed by a solid and credible business case crafted to meet the concerns of the decision makers."

"The first and probably most significant advantage Optus had was...Link Communications, a paging company and subsidiary of...Bell South"

"Early on it announced the involvement of UK operator, Cable and Wireless. This had the double advantage of a partner, which through its subsidiary Mercury Communications in the UK knew what is was like to take on a monopolist (sic) carrier and which had experience running an international telecommunications network. Bell South and C&W together were enough to scare off most of the so-called 25 expressions of interest proving that if you look and act a winner you can often become the winner."

"One local partner, Mayne Nickless, gave the consortium a strong base in local industrial practices...Through Mayne, Optus managed to covert the communication's union from being a trenchant critic of competition, with threats only 12 months old of refusing to connect the second carrier into the Telecom network, into a positive supporter in Canberra. Not only a supporter but a critic of the opposition..."

"In contrast the opposition Kalori, decided to keep quiet, strangely arguing it was a commercial bid. In reality it was clear Kalori was a long way from having its bid in final form.

This reflected Kalori's biggest problem, a consortium group which had partners with very different ideas of how they were going to play it and who was really in charge."

Tom Burton, Sydney Morning Herald, December 14th 1991.

The award was, and is still, subject to final agreement on detailed financial arrangements and the actual closing of the sale of AUSSAT is now scheduled for January 31st 1992.

OPTUS DEVELOPMENT PLANS

The key elements of the Optus proposal to the Government were:

- Rapid Rollout
- Partnership with Suppliers
- Skills and Experience of Foreign Partners
- Australian Ownership
- Market Benefits

Of these, only the Rapid Rollout and Market Benefits remain to be demonstrated.

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Rapid Rollout

Market	Date
Cellular Resale	5/92
GSM Cellular	6/93
STD/ISD Coverage	
45%	12/92
70%	6/93
100%	12/96
Business Network Services	6/93

By the middle of 1993, Optus service offerings will include the following:

- Domestic and International Long Distance Service
  - Directly connected access
  -Indirect access
  -Operator Services
  -Calling Cards
  - Freephone Services
- Wireless Services
  - Resale of Analog Mobile Service
  - GSM Services
- Business Network Services
  - Centrex
  - Private Lines
  - Virtual Networks
  - Facilities Management
  - Consultancy and systems integration
  - ISDN
  - Video Conferencing
  - Facsimile Services
- Satellite Services
  - Transponder Leases
  - RCTS
  - VSAT Data Services

Partnerships with Suppliers

Optus strategic suppliers include the following companies, or their Australian subsidiaries

- Nortel
- Fujitsu
- NEC
- DEC
- Exicom
- Leighton Contractors
- Olex Cable
- Nokia

The fundamental relationship between Optus and its suppliers concerns training, Australian content in manufactured products and R&D commitments in Australia.

While most of these relationships are for the delivery of technology products in production, the development of Optus' OSS (Operational Support Systems) has attracted widespread interest and may well have had significant impact on its overall bid.

It is extremely rare for an major telecommunications company to attempt, or have the opportunity, to develop a complete suite of support systems from scratch without having to integrate or otherwise dispose of its existing systems. In most cases, carriers have developed systems to perform specific tasks at different times and it is rare for more than two or three of them to be able to communicate and share data.

Optus, with Digital Equipment Corporation, Australia as its prime contractor, systems integrator and potentially joint venture partner, intends to develop a totally new, fully integrated OSS. This development will not only provide Optus with the tools to compete effectively on service, but will also represent a potentially valuable saleable commodity.

In terms of available skills and development costs, Australia is an excellent location for the development of major software and the Optus OSS could become a significant source of export earnings.

Market Benefits

The general benefits to the consumer derived from competition in the provision of services need no repetition in this paper. Specifically Optus has predicted that the advent of competition will reduce the cost of long distance and international calling by 40% in real terms over the next five years and by 60% in the next ten years. It should be remembered that Australia already has some of the lowest prices in the world for long distance and international telephone service. Lower, for example, than the United States on a per minute/per mile comparison of most long distance tariffs.

A less tangible, but nonetheless important benefit, will be an improvement in standards of service which, according to many Australians, is a process that has noticeably started already.

SUMMARY

Around the world, more and more countries are experimenting with the introduction of competition in telecommunications. The completely laissez faire free market approach is being tried in New Zealand. Regulated competition from multiple service providers is changing the face of telecommunications in Japan

The Australian experiment is unique in that a regulated, limited term, duopoly has been created in an environment where competitive services can be delivered rapidly to the majority of the population. A major national and international carrier can be built from scratch, taking advantage of the latest technology without the burden of an existing obsolescent infrastructure. This is an opportunity which has been seen nowhere else in the world, but it could very well become a model for other countries to follow.

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TECHNOLOGY AND CHANGES IN VIDEO MEDIA

By Alan (Al) Levin
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Washington, D.C., U.S.A.
Presented at The Pacific Telecommunications Conference
Honolulu, Hawaii, January 1992

ABSTRACT:

Rapidly evolving technology and a spirit of global access and deregulation will modivate "The Video Media Establishment" of today to continuously redefine itself.

New and old players alike who represent massive amounts of collective telecommunication bandwidth, will access "dynamic" and "seamless" digital highways. The term "video media" will broaden, to be thought of as "multi-media" toward and through the end of the decade.

Until about 10 years ago, a paper on technology and the video media would center on TV network broadcasters with deep pockets who freely used technology to enhance their product. These were "over-the-air broadcasters," not cable entities, and they accounted for over 91% of TV viewership in 1980. Today their share hovers at 60% and is dropping.

The economics of broadcasting was changed by technology and deregulation. The diffusion of audience share now motivates broadcasters and cable entities alike to use technology to reduce overhead in an attempt to maintain profit margins and competitive status.

The milestones that sowed the seeds of this diffusion of viewership were evident to only a few in the early '80s. In hindsight, a clear cause-effect pattern is evident.

1. International satellite communications that developed during the early and mid-'60s brought the Vietnam War into American homes. This had the effect of elevating TV news, as opposed to the print media, to the primary source of news for the American public.

   This was a boon for networks then but was also the technological seed for the proliferation of cable TV via satellite - an economically diffusing force for the networks now.

2. The development of ENG - electronic news gathering - that occurred in the early and mid-'70s. This technology involved small electronic cameras and their associated video tape and microwave units to replace film cameras in the field. The almost obligatory local "live shots" became the norm during the late '70s, further enhancing the prestige of the video media in the public eye.

3. SNG - satellite news gathering - made it practical for ad hoc coverage of major events by news cooperatives - allowing independent stations to cover national and international events as never before.

4. Both SNG - fly-away-transmission systems - and ENG camera technology brought the invasion of Panama and the Gulf War into homes more dramatically then ever before. SNG made "live shots" commonplace on a global scale.

   Deregulation along with new and diverse technologies, will continue to drive change in the global video media in the '90s.

   We see a continuation of a pattern where technology and deregulation first aids the media "establishment of the day" but through increased efficiency begets opportunities for a new and broader media "establishment of tomorrow." This was CNN's path.

Fifty to 100 or more cable or DBS channels are taken for granted by today's youth. In my youth, 3 channels were the norm, and my parents were more than satisfied with radio.

Thus just to hold its own, today's video media establishment must keep pace with technology and deregulation while maintaining its client base.

In this sense, video media must constantly "re-invent" and "redefine" itself into a changing environment for it to grow and prosper. If an entity cannot grow with rapid advances in technology and deregulation, its very survival will be threatened. Loyalty to an industry is admirable, entrenchment in a fixed technology can be fatal. Technology will always change.

Our company was founded about 11 years ago, primarily to provide non-editorial technical services to foreign broadcasters based in Washington, DC. We provide camera crews to collect news, videotape editing services, and studios. We added a 7-antenna teleport 2 years ago because of increased demand for transmission services.

We have had to avail ourselves of all the latest technologies to stay ahead of the crushing effect of technological advancement. We developed (in house) a fly-away video uplink system with a communications package so that we could properly serve our clients. By adding technical redundancy, the communications package, and 5 channels of program quality audio, we were able to stylize the uplink system to our particular client base.

In the case of our work with Wold International, we developed an advanced computer control system so Wold could route signals for its clients with maximum control and flexibility.

Over the years, we have seen our client base expand to include US-based networks and cable entities, corporations, governments, and educational institutions. The term "news" or "media" can still be loosely applied to the majority of our client base.

News is a relative term, be it local, national, or international and can pertain to a narrow industry or special interest group. For instance, we do a lot of work involving "VNRs" - video news releases. This usually relates to an industry or special interest group. We work directly with the White House to do point-to-point full motion, broadcast quality, teleconferencing. This allows the President to address larger groups, usually conventions, without the time and expense of travel. During the election year, we will be doing a lot of media campaign work. We call this EWC - Electronic Whistle-stop Campaigning - and this always makes news in one way or the other.

Increasingly we see that the term "news" is interchangeable with information and knowledge. Its exact focus can change from client to client. Raw news is edited and given whatever "spin" a client desires. That's their editorial call and is a direct extension of freedom of the press.

We provide a working platform with information or news pools that our diverse client base share. Thus, we are able to reduce cost through technology and pooling clients together informally when covering big news stories such as wars and political conventions.

If one equates news to information and knowledge, then the distribution of knowledge is the root and destiny of the continuing re-invention and redefinition of video media. This is our industry.

We look for the following:

1. The free flow of information will increasingly define economic and social vitality, analogous to the opening of trade routes in the 1700s and the interstate highway systems in the 1950s.

   Free flow with a minimum of regulation is the key here. Just as a highway that ends or becomes restricted by a national boundary is compromised in its value, so are telecommunications paths that are restricted by jingoistic policies or closed architecture.

2. Along with global deregulation, telecommunication technology must become "seamless," "dynamic," and "on demand."

   This implies that digital technology, with open-ended architecture, will dominate.

   a. "Seamless" - The bandwidth occupied by the digital path will, in most cases, be a mix of various fiber and satellite paths selected by complex optical computer switches. The user of such a system will be able to activate a "class" of services based on performance/economic criteria.

   b. "Dynamic" and "On-demand" - This is critical for economic, video, or high bid rate data service such as our client base uses.

"Broadcast quality" will probably imply compression with a minimum of 8 to 40 mbs when HDTV-criteria is considered. A broadcaster wishing to backhaul news or sports feeds to its hub must be able to dynamically create and expand a digital path on deregulated highways to compete economically. This is true NOW in today's world and is greatly needed.

Bandwidth on demand is not currently available for analog video. The 4 American TV networks each maintain 24-hour transponder paths over the Atlantic, costing each over a million dollars per year. Eighty to 90% of the time, test signals traffic these paths as news and sports feeds occur intermittently.

The only time I can remember that this arrangement made any economical sense was during the Gulf War when there was 'round-the-clock coverage. At times, these non-dynamic paths would "bottleneck" due to simultaneous events occurring in various parts of the region.

c. Near the end of this decade, low earth orbit satellites, or LEOs, will provide dynamic bandwidth on demand. This class of transmission service will be priced at a premium but should allow for easy video access from virtually anywhere on earth with small lightweight equipment that is easily transported as passenger aircraft baggage.

d. The new buzzword will be "multi-media" where computers that access advanced ISDN services are used to route and collect and edit video news material from diverse global sources. The computer terminal, or work station, will manage this flow, replacing the video-tape editing rooms of today and will incorporate an integrated and shared newsroom database. Finished products will again be delivered via ISDN to our clients' final hub. Multi-media will also give our clients instant access to archival news material so breaking news stories will be easily capable of showing historical perspectives.

The changes implied by the re-invention of "video media" are, at first glance, deeply challenging if not frightening. We see established networks and divested former telecommunications monopolies struggle to hold their

own in a changing world. Change - where there was once perceived stability.

I believe that the mix of businesses which we are colleagues in is an industry simply based on information flow, perhaps the most rapidly growing industry of our time.

Its beginnings trace to the dawn of spoken language and its first technological breakthrough was possibly smoke signals. Its future is as boundless as its past.

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PACIFIC TELECOMMUNICATIONS CONFERENCE '92
Remarks for Mr. Ronald J. Mario
President of COMSAT Mobile Communications
Wednesday, January 15, 1992

Good afternoon ladies and gentlemen. I'm Ron Mario, President of COMSAT Mobile Communications, which serves as the U.S. partner and largest owner in the international organization known as Inmarsat. COMSAT is based in Washington, D.C., and is the largest provider of mobile satellite communications services around the world.

The organization was originally called COMSAT Maritime Services, but is now called COMSAT Mobile Communications, since it has added Aeronautical and Land Mobile to its family of mobile communications services.

My remarks today will focus on just those issues that effect Mobile Satellite Communications (MSS), but I believe they will be pertinent since spectrum allocation for mobile communications is such an important topic at next month's World Administrative Radio Conference.

The key message that I'd like to get across to you and to everyone who may have an impact on the outcome of the WARC is that competition is healthy for the mobile communications industry, but the extremely limited amount of spectrum that is available for mobile satellite services is limiting the potential for competition. For there to be true competition, customers need to have a choice among services and suppliers, but the limited spectrum available severely limits those choices. This issue will become critical in the very near future as the demand for mobile communications continues to grow.

Sixteen years ago COMSAT launched the world's first mobile communications satellite to provide ships at sea with a way to communicate that was reliable, private and accessible 24 hours a day from any location in the world.

Five years later, about the same time Inmarsat was formed, there were 1000 users of the system. Today, that number has grown to 18,000. And that number is expected to grow exponentially in the next two to five years as we bring on smaller, more portable and less expensive mobile terminals. They have the potential to revolutionize the way we communicate around the world.

We've already started to see the explosion in growth from many different directions: From private and commercial aircraft that need instant communications with ground control or their home office; from reporters like Peter Arnett of CNN using land transportable satellite communications to cover Persian Gulf developments as they occurred; from Red Cross volunteers helping disaster victims get back on their feet after a devastating earthquake.

The explosion is also coming from individual consumers who have already started to equip their pleasure craft with smaller, more affordable Inmarsat-C text messaging services. And they will soon be able to take advantage of low-cost digital voice, fax and data services from the upcoming Inmarsat-M service, which COMSAT will be introducing later this year. These services will bring the benefits of reliable communications via satellite to hundreds of thousands of consumers all over the world.

There are also a half dozen companies developing the systems that will allow hand-held devices to operate over satellites in the very new future. And some, like Inmarsat, are targeting these systems to be available before the end of this century. People will be able to take the hand-held terminals anywhere, and use them anytime--to call London or Moscow or Cairo. They can take then with them when they go to the Aleutian Islands or to Tonga--and they'll be able to communicate the same way that you and I communicate each day, when we pick up the telephone to call our spouse, or send a fax to a

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business associate half-way around the globe. Some of these systems will use geosynchronous satellites (GSO); some may use Low Earth Orbit, or LEO, systems; and some may use High Elliptical Orbits (HEO) or a combination of systems.

But regardless of which systems are used, the actions that will be taken at the up-coming WARC could have far-reaching effects on not only Inmarsat and COMSAT, but on the plans of all the other hopeful Mobile Satellite service providers waiting in the wings to see how much spectrum will be made available for these services.

The available spectrum for mobile communications is in critically short supply, and that is the single biggest barrier to allowing new service providers onto the scene. It ultimately may not matter which organization is allocated the spectrum, because there is only enough to offer a limited range of services and not enough to create the volume necessary to significantly reduce prices for the customers who want and need the service.

To illustrate how little capacity is available today for Mobile Communications: did you know that the entire mobile community today -- and I'm referring to all existing or authorized mobile systems including Inmarsat, Aussat, the Soviets and AMSC, combined -- operate on the equivalent of 1 transponder on 1 INTELSAT satellite? INTELSAT, by the way, has 16 satellites with 27-48 transponders per satellite. These mobile systems use about 30 MHz of spectrum, compared to INTELSAT's 575 MHz at C-band plus 500 MHz at K-band.

It is in the public interest for new companies to enter the mobile market, but they can't without taking spectrum currently allocated to other mobile service providers, because we're all competing for a very scarce

resource. Therefore, many of the issues facing us at next month's WARC are crucial to the entire mobile industry's survival. And here's what we at COMSAT would like to see happen there:

1) A mobile satellite allocation for LEO satellites in the RDSS Bands: 1610-1626.5 and 2483.5-2500 MHz--plus a secondary allocation (space to earth) for MSS in 1613.8-1626.5 MHz.
2) Additional spectrum made available for geosynchronous mobile satellites. To meet the extensive demand forecast by the CCIR, we need a minimum of 125 MHz of new spectrum by 2010.
3) The best result would be enough spectrum to accommodate both LEO and GSO satellite systems, so customers truly have options.
4) We must also protect safety-related services in the existing L-band: GMDSS in Maritime (lower 14 MHz L-band) and Aeronautical communications related to safety and regularity of flight in the Aeronautical band (upper 10 MHz L-band)--these are special obligations that Inmarsat and the U.S. (Coast Guard/FAA) share.

We believe these actions will serve all the Mobile Satellite service providers and will offer the most opportunity to expand competition in the industry. Thank you.

KEYSTONE
COMMUNICATIONS

OUTLINE OF REMARKS BY

PETER MARSHALL
PRESIDENT, KEYSTONE COMMUNICATIONS
USA

AT
PACIFIC TELECOMMUNICATIONS CONFERENCE
14 JANUARY 1992

(SESSION NO. 3.2.4.3)

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This panel does not include a speaker from INTELSAT, which obviously has an important role in considering the subject of Regional satellite systems for the Pacific. I do not intend to speak for INTELSAT - there are others here from that organization who will do so effectively in other panels. But I will try to add an INTELSAT perspective to our discussion. I do so as a former executive of INTELSAT, and now, in my new capacity, as a major user (not for the first time).

Keystone has recently signed a contract with COMSAT and KDD for the full time lease of an INTELSAT Pacific Region transponder to provide video services from the US to Japan and to other Asian countries. I am and have always been in favour of private systems and competition in the international satellite market. I want to see choice and competing services and innovation which will stimulate the market and help it to grow even faster. I applaud the success of ASIASAT in this region and PANAMSAT in the Atlantic; and I welcome the endeavours of Mat Nilson and all the others who have been planning international satellite ventures here for so many years. But my files are full of statements and forecasts about start-up dates which have not been fulfilled. I sympathise with TONGASAT and PACSTAR and CELESTAR, FINANSAT, and COLUMBIA and understand the problems which they and their promoters have continued to face as they tangle with Governments and PTTs who have controlled telecommunications for so long. So often it is one step forward and two steps back - hopes and promises fulfilled or delayed. So when Keystone decided to enter this market it was still Hobson's choice - INTELSAT or nothing if we were to start the business now. I would have dearly loved to have some options, some competitive quotes for the space segment - and I might still have chosen INTELSAT because of its coverage and connectivity, the potential for back-up capacity and for future expansion. But in the real world, away from the conference and press reports, there is still no choice in 1992 for transpacific services.

Despite all their problems with capacity shortages, INTELSAT has managed to meet most requirements for video leases and other non-voice services by juggling with transponder assignments and by building up confidence in their inclined orbit satellites. The broadcasting users viewed the prospect of inclined orbit very reluctantly, even with hostility, at first - I remember it well, I was there at INTELSAT when we first discussed this solution with the users. But when there is no real alternative, even the broadcasters became pragmatic and looked at the benefits of lower tariffs while the engineers coped with the technical requirements. Now there are even those in the industry who are so conditioned by the experience that they are asking whether the economics of fixed station-keeping are really justified? How about putting new satellites into inclined orbit straight away and providing services based on a 20 or 25 year satellite operating life? That certainly alters the satellite vs. cable cost argument. The instinctive reaction is to say "no way" - this would be offering second-class service in a market used to high grade engineering standards. But stranger things have happened and it would not surprise me if extended life satellites (that's a more palatable description than inclined orbit) became at least a part of the permanent satellite system - whether they are operated by INTELSAT or by the private sector.

Of course, INTELSAT's need to consider this option and indeed their ability to compete in this region for the rest of the decade - will depend to a great extent on the successful launch of the new INTELSAT - 7 series, and on the recovery and relaunch this spring of the INTELSAT - 6 which is still stranded and in low earth orbit. If they have 100% success with the launch program in the next couple of years, they will be able to recover from the current capacity shortages in the Pacific, for transoceanic and regional services. They will also be able to expand and develop new services including the additional Ku-band spot beams on the sevens. The private system operators - including those here on this panel today - must now be planning to enter a

marketplace in which a revived and strengthened INTELSAT will be competing. The window of opportunity to exploit INTELSAT's capacity shortage is probably closing. Hindsight is easy, but if PANAMSAT or any others had been able to finance new satellites for this region five years ago, and had been able to pressure the regulatory mandarins in Asia as successfully as they have done in Europe and South America, they would be reaping the benefits today.

But unless INTELSAT runs into further capacity problems through launch failures, I think that opportunity has now gone and the realistic scenario for the rest of the 90s is one in which those private operators who actually get into business will be competing principally in the specialized markets - such as video, VSAT services, INTELSAT and its members will continue to dominate the public switched networks and those services which require universal coverage, where they will also increasingly compete with the undersea cable systems.

Within this scenario, there are certainly welcome signs of change and relaxation of the regulations in some Asian countries, sufficient to encourage me to take the first steps with Keystone to enter the video transmission services market. The concept of service providers and space segment resellers has been one of the elements in stimulating the growth of the industry in the US. The same concept has become successful in the Atlantic region through Brightstar. And now, the opportunity has come to start something similar in the Pacific Region.

The Asian countries are changing and opening up their telecommunications markets - but slowly and carefully, according to their own agendas and their own needs. As American car manufacturers learned the hard way last week, apparently to their surprise, Asia is different. As everyone on this panel knows, business

relationships there are built slowly and patiently and professionally. That way, in time, there will be alternatives available in the Region, and when Keystone needs a second or third transpacific transponder, we will be able to have a real choice. I look forward to that day.

BIOGRAPHICAL NOTES

Peter Marshall has more than 25 years of experience in senior positions in the broadcasting and satellite communications areas, working in both public and private sectors.

He was recently appointed President of Keystone Communications, a US-based satellite transmission services company which provides US domestic and international video service, mainly for broadcasting and business communications uses. He was formerly with INTELSAT in Washington, DC.

Mr. Marshall is British, and after service as an officer in the Royal Navy, he began his career in broadcasting with the BBC. He then moved to Visnews Ltd., the London-based international news and communications company, where he became General Manager and CEO. During this period, he was closely involved in the development of satellite distribution for broadcasters throughout the world. He also created Brightstar Communications, the first company to lease international satellite capacity for third party traffic.

This experience led to his appointment in 1986 to INTELSAT in Washington, DC as Deputy Director, Broadcast Services. INTELSAT is an international cooperative organization of 117 member nations. It owns and operates a global system of 13 communications satellites which provide voice, data and video services to users in 170 countries of the world. At the end of 1988, he joined a Washington, DC telecommunications consulting group.

Mr. Marshall's career has spanned many aspects of television and international communications, and he developed a wide range of industry contacts in the UK, USA and many other countries.

Mr. Marshall was vice Chairman of the Royal Television Society in 1984 and 1985 and was elected Chairman in 1986. He was a founder member of the UK Space Society and is President of the Washington-based Society of Satellite Professionals International.

He is the author of a number of papers and articles, notably on the role of satellite communications in the development of international broadcasting; and he has presented papers on related subjects at conferences in the United States, Europe and Japan.

Remote Telemetry Applications in Micronesia

MCCONNELL, J.; B. R. BEST
University of Guam, Mangilao Guam 96923

SUMMARY

The University of Guam College of Agriculture and Life Sciences has been exploring the use of a specialized packet modem data transfer package designed to relay remotely logged field data to a central hub in the Micronesia Islands. The data can then be transferred to other sites via the GOES PEACESAT system. Incorporated with the Mallard electronic mail system (see Cohen et al. PTC'92), remote data can be forwarded around the islands and internationally.

Originally, the authors designed the system with a packaged packet modem system and sensors. The sensors collect data on the environment and plants. Field modifications have enhanced the system for use with a Macintosh computer for Micronesian experimental applications. Software was developed for automatic local data retrieval. This system will link remote solar powered UHF RF links through the local loop or simplex VHF or HF radio into the district or state educational GOES PEACESAT uplink to be received by other similarly linked Pacific Island experimental field sites.

Previous Micronesian computer/voice-integrated networking experiments were carried out through the PEACESAT ATS-1 satellite and commercial carriers. The high cost and lack of local loops in Micronesia have made normal BBS or duplex systems infeasible. This paper will review the problems encountered and the benefits of this remote electronic mailbox network.

KEYWORDS: AGRICULTURE, DATA TRANSFER, PACKET RADIO, SOFTWARE, MACINTOSH

INTRODUCTION

During the past few years we have used various equipment which produce large quantities of data. It is becoming increasingly common to interface the equipment to computers. The level of communications between the equipment and the computer varies greatly ranging from simple data transfer to allowing complete remote control. We have used equipment with various levels of communications abilities. I would like to describe 3 types of equipment we have used.

HPLC

The HPLC is used for the separation of various compounds in liquids. This particular system is controlled by a Macintosh. There is a control box which connects to the serial port. The computer controls the equipment and also stores data. Two different data loggers are currently used for collection of weather data. Weather data is important in agriculture for identifying plant responses to treatments under various environmental conditions.

DATA LOGGERS

Two types of data loggers have been used. One type is a small self-contained unit that must be removed from the field and brought into the lab for connection to a computer. A standard communications program is used for data transfer It is very easy to set up the logger however it has limited flexibility for customization. This logger is good for short term data logging. It has the capacity to store about 3 months of data. A modular, multi-component system is the other type of logger we are using. This system has increased flexibility. Many options are available for configuring sensors. The format for the storage and transfer of data are also flexible. There are two main formats of data storage and transfer:

1. EPROMS. Data is stored in removable EPROMS. The EPROMS are removed from the logger and taken to a reader which is attached to a computer. The disadvantage to this method is that the EPROM must be removed from the unit to transfer the data and for erasing the memory. The advantage is that the storage is non-volatile.

2. RAM packs. This is volatile memory and data stored will be lost with loss of power to the logger. Data transfer is either accomplished by directly connecting a computer to the logger in the field or by remote connections. The data is can be transferred via telephone lines or radio. It was desired to make the transfer of data from the weather stations as easy and efficient as possible. It

was decided to set up the weather station for remote data transfer. Along with data transfer, data storage is an additional consideration.
Today I would like to describe our weather station configuration and show our software we use for storing the accumulated data.

Logger Configuration

Due to current limitations with telephones on Guam, it was decided to use radio with packet modems. An additional advantage is the flexibility of moving the location of the station allowed with radio. With telephone connections, a telephone line needs to be installed to each site. Originally, the system was installed with a packaged packet modem system and sensors. The sensors collected data on the environment and plants. This communication package was a commercially available. Once this system was installed and in operation, the communications system was customized with locally available components.

Software description

As mentioned earlier, besides developing the means to conduct remote data transfer a database was developed to store data. The database was developed to store information on agricultural experiments. 4th Dimension was customized for this purpose.
There are multiple files in the database. It is a multi-purpose database that stores different types of data including weather data. I would like to describe some of these features. The database has been under development for 5 years. Among the goals was the desire to have an easy to use interface. The basic layouts have buttons in similar locations. It was set up to function like HyperCard.

Accessions

One file is basically a plant inventory (Figure 1). Information is stored on plant material. Much of the plant data is on orchids such as this dendrobium. As new plants are entered into the database, a unique ID number is assigned by the computer to each plant.

Experiments

Another set of files handles the definition of individual experiments. Each experiment is entered as an individual record. There are multiple screens included in each record (Figures 2-5). Data related to the experiment is entered into the specific record. Once entered, the data is posted to another file where all plant data is stored. These are some of the screens included in the experiment record. Figure 2 is the layout for defining the treatments and the parameters that will be recorded. Information such as the interval of data taking is entered. Once the treatments are entered, the plants are assigned to the experiment (Figure 3). This shows the plants that have been assigned to the experiment. Clicking on the Add plants button calls a window which shows what plants are available (Figure 4). Finally this is a Spreadsheet used for data entry. The column headings are defined from pop up menus (Figure 5). Once the data is entered, it is posted to permanent records in another file and this sub-file is cleared.

Weather Data

The weather data files were developed to allow storage of data from multiple loggers in one database. The original design was solely for importing data into the database after it had been transferred with a communications package
More recently communications features have been added for direct transfer from the logger to the database. There are multiple files associated with defining a weather station. One file handles the configuration of loggers. One record is entered for each logger station
The record contains fields for:

- Name of logger
- Location
- Other description
- Number of reports from a logger
- The Li-Cor store one report
- The Omnidata can store 3 with different variables and report intervals
- A sub-record stores information on each of the reports (Figure 6).
- 1 to 10 fields of data are defined per report
- The name of the field
- The type of data--instantaneous, average, sum, maximum, minimum
- Interval reported
- The database generates an ID to assign to the various reports

Once a weather station is defined, the database will connect to the weather station at the designated time. Once the connection is

established, data is transferred and the loggers memory is cleared and then the communication is disconnected. This is all accomplished by the database.

The entire system is capable of being battery powered. The weather stations are solar powered. During the last typhoon, the weather data was transferred the day after the storm even though there was no power on the entire island. Figure 7 shows some weather data that is stored in the database. The database has the capabilities of producing graphs of desired data through the use of 4D Calc and 4D Graph. FIgure 8 is a plot of solar radiation data. Figure 9 is a plot of humidity, temperature and wind speed.

DISCUSSION

Difficulties

One of the difficulties we did experience was in powering the weather station. The solar panel originally supplied with the commercial package was found to be too small. This was replaced with a larger panel.

There has been some interference from other sources. This problem was addressed by shortening the packet length.

Uses and Future Goals

One of the attractive features of this system is it flexibility. It is very easy to set up a weather station in a remote site without needing to make frequent trips to the site for data transfer. While currently we are using this system for weather data, this system could be used for the transfer of other types of data. One goal is to explore the use of other radios and to utilize GOES PEACESAT to allow data transfer among islands. Various approaches are currently being explored for allowing the data to be stored on a hub computer that can be transferred as subsets to other sites.

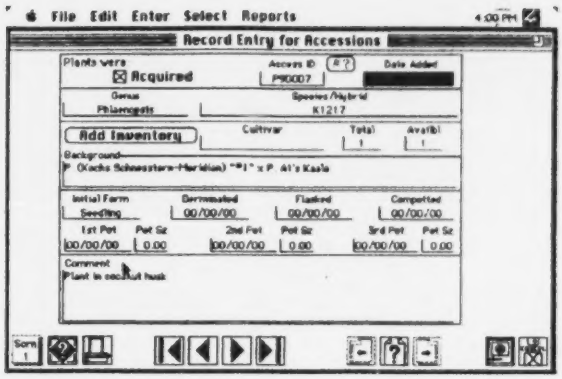


Figure 1. Database layout for entry of plant information.

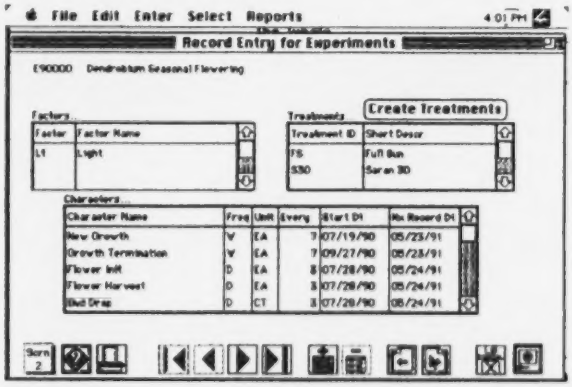
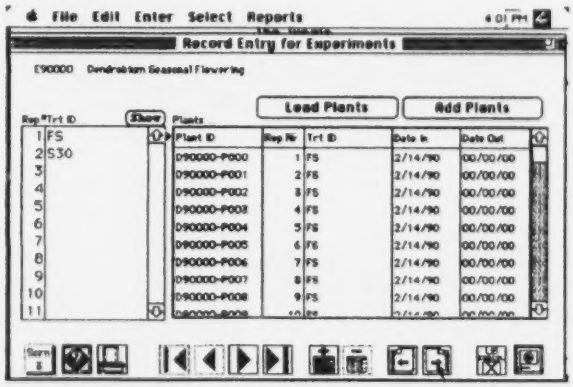


Figure 2. Database layout for defining treatments and characters.



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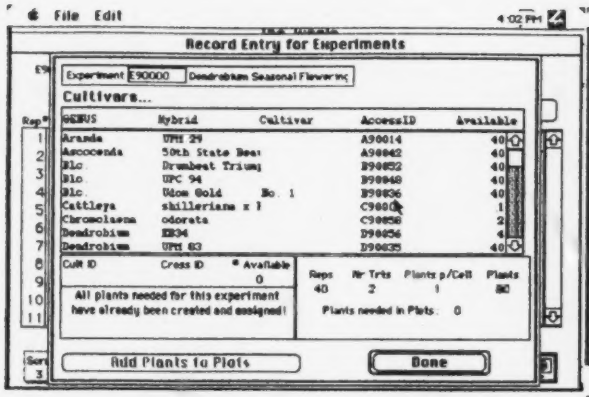
File Edit
Record Entry for Experiments
Experiment E90000 Dendrobium Seasonal Flowering
Cultivars...
GENUS Hybrid Cultivar AccessID Available
Aranda UPH 29 A90014 40
Ascocenda 50th State Beau A90042 40
Blc Drumbeat Triumj D90852 40
Blc UPC 94 D90848 40
Blc Udom Gold Bo 1 D90836 40
Cattleya shilleriana x 1 C9080 1
Chromolaena odorata C90858 2
Dendrobium E834 D90856 4
Dendrobium UPH 83 D90835 40
Cult ID Cross ID * Available
0
Reps Nr Trts Plants p/Cell Plants
40 2 1 80
All plants needed for this experiment have already been created and assigned!
Plants needed in Plots: 0
Add Plants to Plots
Done

Figure 4. Database layout for plant inventory used in assigning plants to experiments.

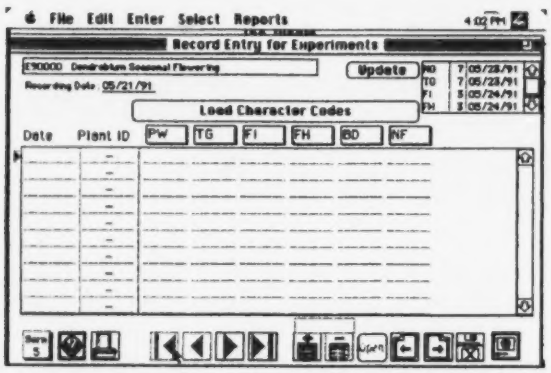
File Edit Enter Select Reports
Record Entry for Experiments
E90000 Dendrobium Seasonal Flowering
Update
Recording Date: 05/21/91
Load Character Codes
Date Plant ID PW TG FI FH BD NF

Figure 5. Database layout for data entry. Columns are defined by pop up menus.

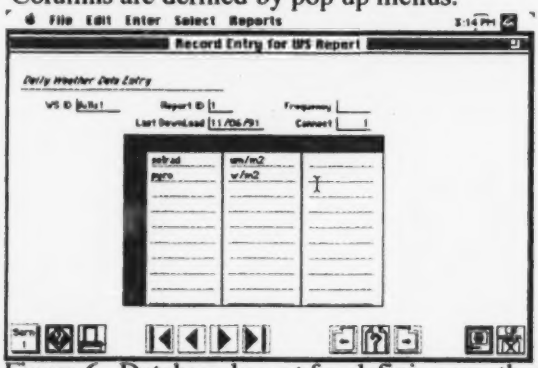

Figure 6. Database layout for defining weather station reports.

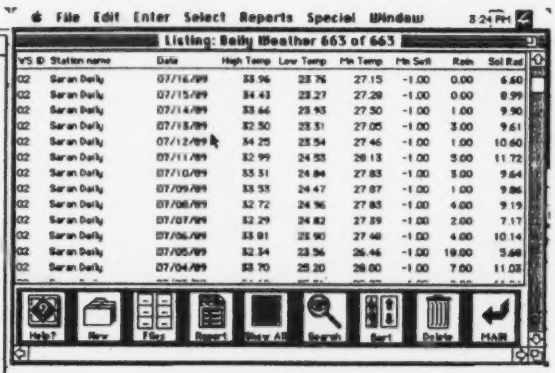
File Edit Enter Select Reports Special Window
Listing: Daily Weather 663 of 663
VS ID Station name Date High Temp Low Temp Min Temp Min Soil Rain Sol Rad
Help? New Files Report Copy All Search Sort Delete MAIN

Figure 7. Database layout showing weather data.

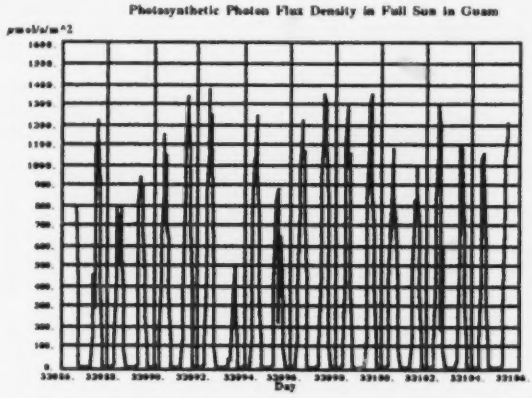

Figure 8. Plot of solar radiation from sample weather data.

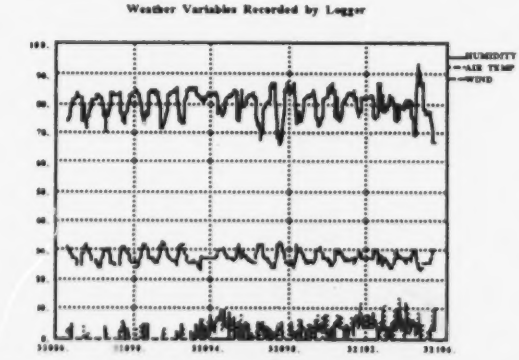

Figure 9. Plot of humidity, air temperature, and wind speed from sample weather data.

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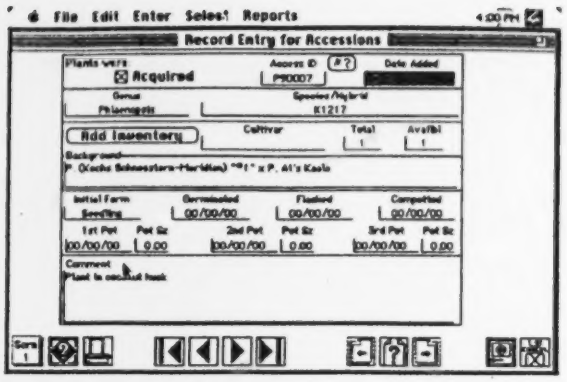

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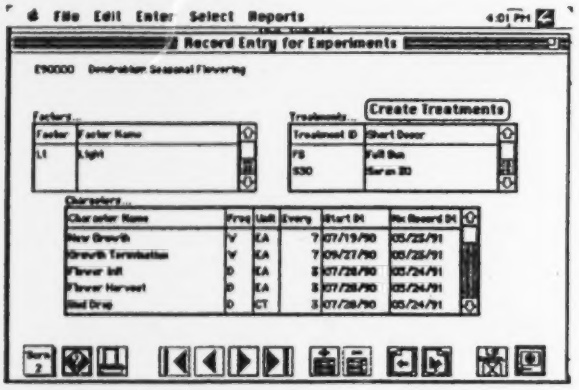

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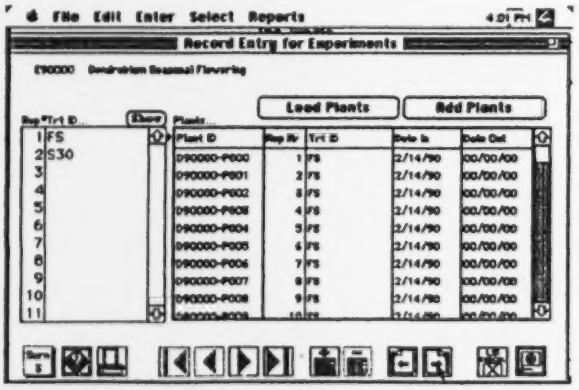

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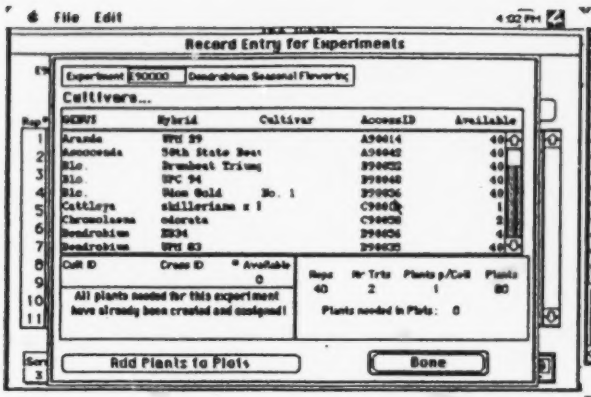

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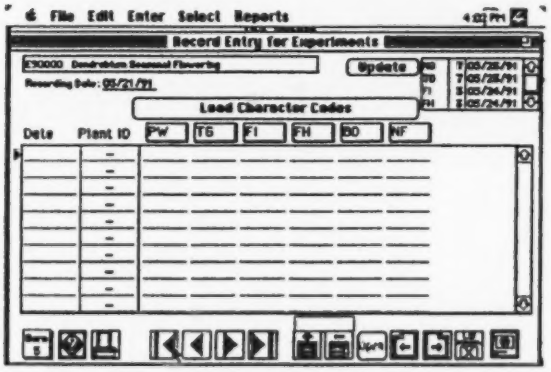

Figure 5. Database layout for data entry. Columns are defined by pop up menus.

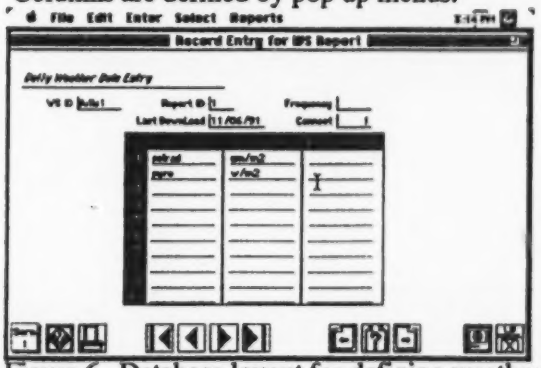

Figure 6. Database layout for defining weather station reports.

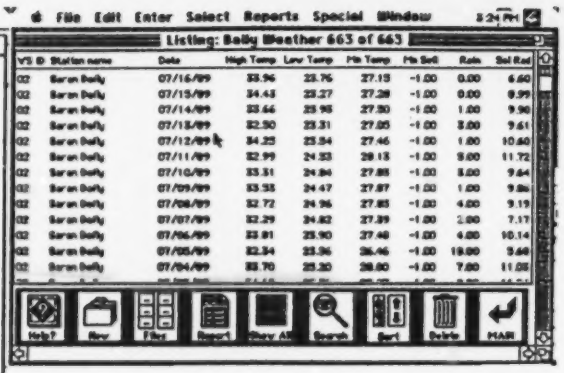

Figure 7. Database layout showing weather data.

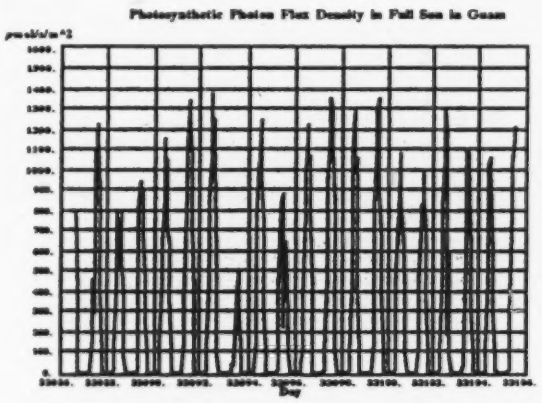

Figure 8. Plot of solar radiation from sample weather data.

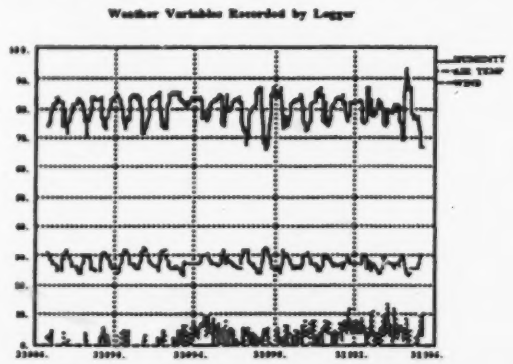

Figure 9. Plot of humidity, air temperature, and wind speed from sample weather data.

NYNEX'S CUSTOMER ACCESS NETWORK

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ABSTRACT

NYNEX's Customer Access Network is currently undergoing a major modernization program. In order to support NYNEX's VISION of deploying an Intelligent Broadband Communications Network, NYNEX wants to accelerate the deployment of fiber based systems in the local loop. This Fiber In The Loop (FITL) program will ensure NYNEX's being strategically positioned to be our business and residential customers' carrier of choice for their full complement of network services.

This briefing will expand upon the aforementioned FITL program. NYNEX's FITL trials of the Raynet LOC-1 System and the BroadBand Technologies, Inc's (BBT's) FLX-100 System will be highlighted. Results and lessons learned from these trials will be presented, emphasizing the criticalness of system costs, operations and loop powering. this report will address the strategic role SONET terminals, Passive Optical Networks (PONs) and wireless technologies (e.g., PCN) will play in the realization of NYNEX's Network VISION. NYNEX's Cable Television (CATV) operations in the U.K. will also be discussed as an alternative loop architecture.

INTRODUCTION

The global telecommunication industry is rapidly evolving towards the deployment of an Intelligent Broadband Communications Network. This Network VISION will enable network providers to satisfy their customers' demands for bandwidth diversity, service portability, user control and simplified user interfaces. Technology advancements in the areas of broadband, wireless, network intelligence and ergonomics provide a one for one correlation to the aforementioned service characteristics:

SERVICE	TECHNOLOGY
Bandwidth Diversity	Broadband
Service Portability	Wireless
User Control	Network Intelligence
Simplified Interface	Ergonomics

This paper will place major emphasis on the first two technologies - broadband and wireless; and how NYNEX plans to deploy Fiber-In-The-Loop (FITL) and wireless technology in its local loop network.

NYNEX's evolution to that broadband infrastructure has, in fact, already started in its facilities networks - interoffice and subscriber loop. NYNEX has deployed over 500,000 fiber miles in its network. Most of that deployment has been in the interoffice network, with a recent increase in the installation of fiber in the feeder plant. NYNEX's deployment of lightwave technology has been strategically targeted. It has focused on areas that are characterized as possessing accelerated market demands, potential competitive pressures and/or modernization requirements. The planning of NYNEX's fiber network is an integrated marketing, technology and operations effort. NYNEX's multiplexing strategy and its Operations Support Systems infrastructure ensures not only the cost effective deployment of technology, but also its efficient management.

NYNEX's infusion of broadband capabilities in its facilities network will continue. Nevertheless, one of NYNEX's biggest challenges is to accelerate the penetration of fiber-in-the-loop, especially in the distribution plant. NYNEX's drive to push broadband capabilities to all of its customers is hindered greatly by the bandwidth limitations of its local loop. NYNEX's local loop is predominantly narrowband (i.e., 64 kb/s). It has a tremendous amount of embedded copper plant. NYNEX's deployment of fiber in the loop constitutes a very small percentage of its loop infrastructure. As technology evolves, so does customer demand for more and more bandwidth (see Figure 1). The loop must be upgraded to the point where NYNEX is strategically positioned to provision, on a general deployment basis, those services requiring greater amounts of bandwidth. The answer is a fiber based customer access network!

TARGET LOOP ARCHITECTURE PLAN

Realizing that services and technology are evolving towards broadband and that several alternative FITL architectures exist as well as a plethora a systems vendors who would be vying for NYNEX's business, NYNEX has spent the last few years developing its target loop architecture. NYNEX's target loop (see Figure 2) will be fiber based and fully SONET compatible. The critical elements of the evolving local loop are:

- Next Generation Digital Line Carrier (NGDLC)
- SONET Add/Drop Multiplexer in Feeder
- TR-303 Standards Compliance
  - TSI Capability
  - Remote, Automatic Provisioning Capabilities
  - Automated Administration Capabilities
- Multiple Switching Machines Integration
- Standard OS/NE Interfaces
  - Enhanced OSSs (with Customer Control)
- Standard P1396 SONET Backplane
- Various Distribution Modules
  - "Traditional" DLC with Programmable Channel Units
  - Fiber To The Curb (PON)
  - Wireless
  - SONET Extension to Customers
  - Intelligent

The feeder portion of the local loop will constitute a physical ring, which will be fiber lean via a logical ring. The distribution segment of the loop will use a topology forming a physical star, which will also be fiber lean - but, via passive optical splitters. This local loop will be upgradeable to broadband.

FITL ARCHITECTURE REQUIREMENTS

NYNEX has conducted a series of meetings with numerous system vendors to explore those vendors' respective views on local loop evolution, as well as the particulars of their specific FITL systems. NYNEX has also issued an RFI (Request For Information) to the vendor community. This RFI delineated NYNEX's strict requirements for FITL systems to be as follows:

- Fiber based systems must provide cost and service parity to copper equivalent systems for narrowband services.

- Fiber based systems must provide a platform from which to evolve towards broadband and to deploy complementary loop technologies.

- Efficient network management capabilities must accompany these systems, whereby operations, administration and maintenance are enhanced.

FITL TRIALS

NYNEX has conducted or is in the processing of conducting two field trials of a FITL System. These field applications are the New England Telephone (NET) trial of Raynet's Loc-1 System in Lynnfield, MA; and the New York Telephone (NYT) trial of BroadBand Technologies' FLX-100 System in Poughkeepsie, NY.

Raynet:

The first system to qualify for a NYNEX field Application is Raynet's Loop Optical Carrier (LOC-1) system (see Figure 3). The Raynet system is a bus architecture which employs a non-invasive coupler at the far end electronics site. LOC cost models are consistent with NYNEX's cost per line targets. An enhanced network management system is integral to LOC.

The NYNEX FTTC application was conducted in Lynnfield, Massachusetts. It entailed the provisioning of 130 lines to a 100 home development, which was an existing neighborhood. This rehabilitation project (REHAB) was consistent with NYNEX's goal to modernize its network with cost effective, state-of-the-art technology. The loop length of this area was 13.9KFT.; thus, a remote terminal (RT) was required. The RT was located in a controlled environmental vault (CEV); it housed a NEC 1840A 135 Mb/s fiber optics transmission system, LOC's head end (office interface unit) and ancillary equipment. This application provisioned telephone services only. The field evaluation with in-service customers began in January 1990 and concluded in October of that same year.

Raynet's LOC-1 comprises six (6) system components; Office Interface Unit (OIU); Subscriber Interface Unit (SIU); Optical Transport; Remote Power Supply (RPS); System Administration Module (SAM); and the Remote Intelligence Distribution Element Support (RIDES) System. The OIU is an intelligent network element that serves as the centralized intelligent node for system configuration and monitoring. It also provides an interface to the fiber optic bus. The SIU is a field deployable fiber optic based remote intelligent network element. It is used to provide narrowband (and eventually broadband) services to the customer. The non-invasive coupler is housed in this unit. The optical-to-electrical conversion as well as the interface to copper drop wires (and eventually to coaxial cable crop wires for video transport) is done at the SIU. The Optical Transport is a bus architecture and is provided by two fibers between the OIU and up to 24 SIUs. Each fiber enables a unidirectional bus that is passively tapped at the SIU. The RPS contains rectifiers, back-up batteries, power cables, power pigtails and alarm lines to each SIU on the bus. SAM is a micro-computer and resident software that administers the LOC system. SAM is a micro-computer and resident software that administers the LOC system. SAM functions include line provisioning, testing, alarm surveillance and the collection of historical data pertaining to LOC. RIDES enables remote flow through provisioning, testing, maintenance and alarm surveillance and retention of historical date for one or more LOCs.

NYNEX's field application of the Raynet LOC-1 system provided an opportunity to conduct a comprehensive review of the technological, operational and service provisioning aspects of deploying a local loop fiber distribution system. Some of the areas pursued were the:

- Development of subscriber fiber access experience.
- Evaluation of alternative loop architectures.
- Assessment of operations support system capabilities.
- Validation of cost assumptions.
- Driving of NYNEX's loop architecture evolution.

The planning, engineering and assessment of Raynet's LOC system was conducted by an intercompany project team. The project manager received corporate wide support in his assembling of a professional cadre to make this project the success that it was. Based on the positive feedback from the LOC-1 evaluation, NYNEX may conduct similar trials of Raynet's LOC-2 system, which is a more powerful, flexible and robust system (than LOC-1) for the local loop. The LOC-2 system also employs the flexibility of the Passive Optical Network (PON) concept.

BROADBAND TECHNOLOGIES, INC:

NYNEX also conducted a lab verification of the narrowband version of BBT's Fiber Loop Access (FLX) 100 system at NYNEX's Science and Technology Center in White Plains, New York (see Figure 4). BBT has developed a digital fiber optic transmission system designed initially to carry POTS to residential subscribers and small businesses; and then to be upgraded to carry video. The BBT system achieves cost efficiencies with an architecture which shares electro-optical components and fiber optic cable between several subscribers.

In the BBT POTS system, a signal containing 16 voice circuits is transmitted from a remote terminal to a pedestal, where it is split passively, and shared among multiple subscribers (up to 16 with 4 being average). The BBT system may be deployed in single star, double star or triple star architectures. In the single star architecture, the BBT Remote Distribution Terminal (RDT) is located in the central office, thereby negating the need for a field deployed remote terminal.

The BBT system consists of the following basic elements:

- The transmission medium, which is a single mode fiber cable, carries signals between a central distribution point and the subscriber. The central distribution point, called the BBT RDT is normally located in the field (remote terminal) but can be located in the telephone company central office.

- Electro-optical devices housed in the ONU's. This element connects the customers to the remainder of the BBT system and converts the optical signal from the fiber to electrical signals used by the telephone and vice versa.

- Electro-optical devices housed in the BBT RDT located in the C.O. or at a remote terminal location. The BBT RDT connects the BBT system to the telephone company network and manages the connection.

- Passive optic splitters are utilized in the BBT FTTC architecture. The splitters are normally located at the curbside and allows sharing of the fiber optic cable.

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- Operations Interface Module (OIM) is a supervisory system which allows for integration of the FITL system into the current telephone company environment. It will be migratable to emerging generic requirements such as TR-303, SONET, etc. A single OIM provides supervisory functions for several BBT systems and acts as a gateway between these systems and various telephone company operations support systems.

This lab verification was completed with satisfactory results; and NYNEX is in the process of conducting a comprehensive field evaluation of the BBT System in Poughkeepsie, NY.

The Poughkeepsie trial, which encompasses 400 living units that account for 470 lines, is the largest NYNEX FITL project to date. The site itself is an area targeted for rehabilitation by NYT. This existing neighborhood calls for the BBT system to be deployed in both aerial and buried configurations. Telephone service is scheduled to be provisioned via BBT's FLX-100 system during 1Q92.

U.K. CATV OPERATION

NYNEX Network Systems (NNS) is developing a telecommunications and cable television business in the U.K. They are the majority partners in eleven franchises, which account for approximately 1.4 million homes passed. NNS officially opened its Portsmouth franchise (along the southern coast of England) in September 1991, when they provided CATV service to customers. They are scheduled to offer telephone service to its customers during 1Q92.

The network architecture being initially deployed in NNS' UK franchise is one that can provision both telephony and video services. The network, which is fiber based, utilizes separate systems for telephony and video that are overlaid on each other (see Figure 4). Efficiencies and economies of scale are achieved by utilizing shared headend/central office facilities, street cabinets and conduit systems. The operations support system is also evolving towards a single-integrated system that will manage both networks and classes of service. As technology matures, NNS' network will become more integrated at the system level.

CONCLUSION

Fiber Access Strategy

NYNEX's assessment of Raynet's LOC system and BBT's FTTC system are the first in a coordinated series of fiber system evaluations. These tests will come both in the form of lab verifications and field applications. The goal of this corporate action will be a resulting understanding of which local loop fiber distribution systems are best suited for the NYNEX environment. Vendor selection and product approval will follow, as well as the establishment of general deployment guidelines.

These fiber system evaluations are critical elements of NYNEX's customer access network strategy. Briefly, this strategy is as follows:

- Continue to evolve NYNEX's fiber network.
- Conduct marketing and technology fiber trials.
- Drive vendors to meet NYNEX's service concepts, technology and operational requirements.
- Accelerate fiber deployment in targeted areas.

This paper has defined NYNEX's FTTC trial program, which will enable and enhance the evolution of our Vision of an Intelligent Broadband Communications Network. Technology and the marketplace are converging and evolving at a rapid pace. Without an equally enlightened evolution of the regulatory/judicial/legislative arena, the achievement of theat Vision will be delayed.

Restricting regulations must be loosened at the federal and state levels (e.g., MFJ restrictions concerning information content and manufacturing, accounting rules, depreciation schedules, price cap regulations, Telco/CATV crossownership rules, etc.) to create that positive political environment which will facilitate the actualization of a fiber based loop infrastructure in not only the NYNEX territory, but the entire U.S. NYNEX's conduct of its FTTC trial program and the resulting analyses are instrumental input to the overall plan to attain those alternative forms of regulatory policy.

ACKNOWLEDGEMENTS

The author wishes to thank the many colleagues who have contributed towards this paper - particular Bob Froelich and Dave Petruziello of NYNEX's Science and Technology; , Bob Boucher, Bill Judge, and Tom Juris of the Telesector Resources Group; George Ballog and Dave Lowe of Raynet; and Salim Bhatia and Rick Jones of BBT - for their invaluable assistance.

FIGURE 1

APPLICATIONS ARE EVOLVING TOWARD GREATER BANDWIDTH . . .

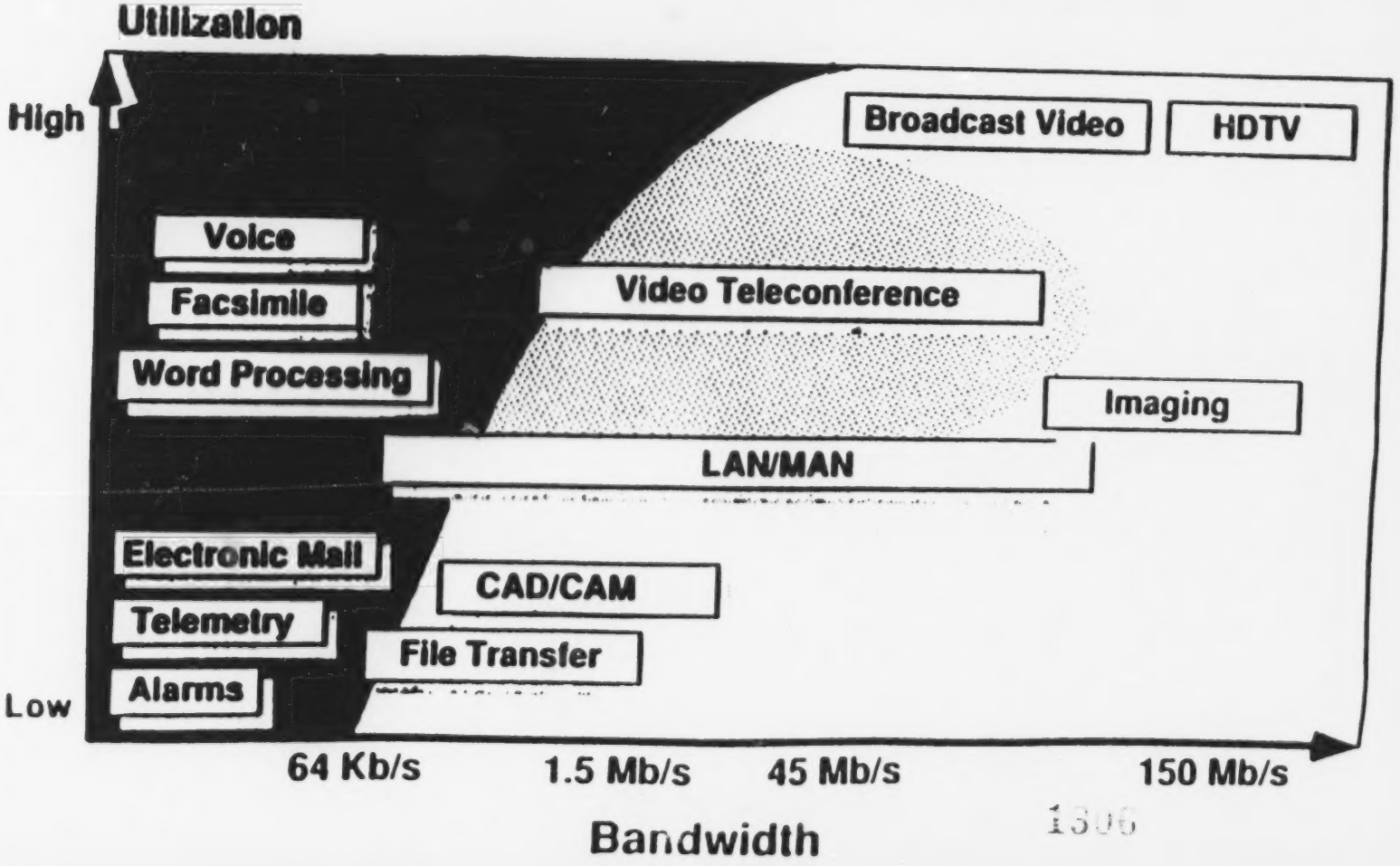

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FIGURE 2

NYNEX Target Loop Architecture

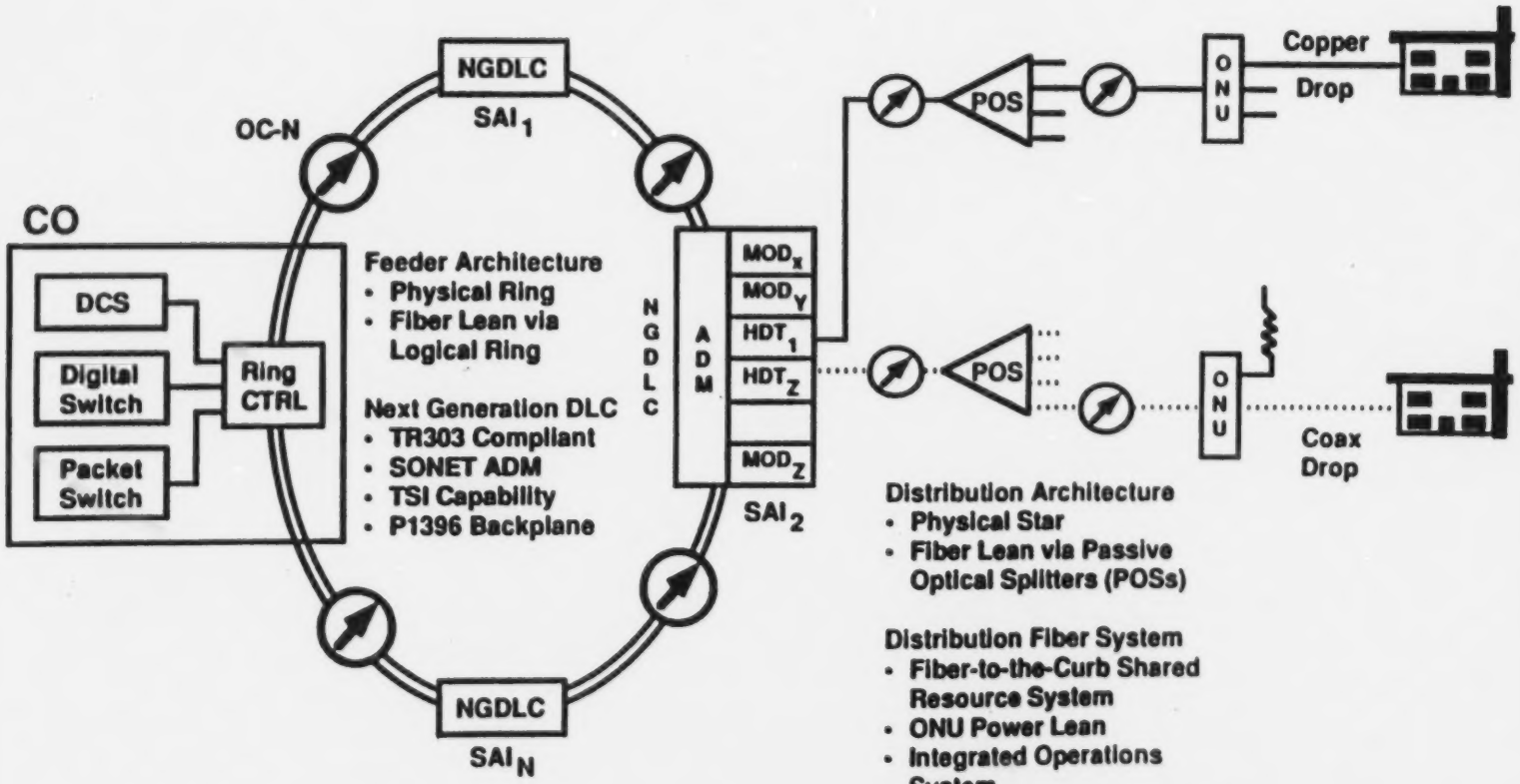


FIGURE 3

RAYNET'S LOOP OPTICAL CARRIER SYSTEM

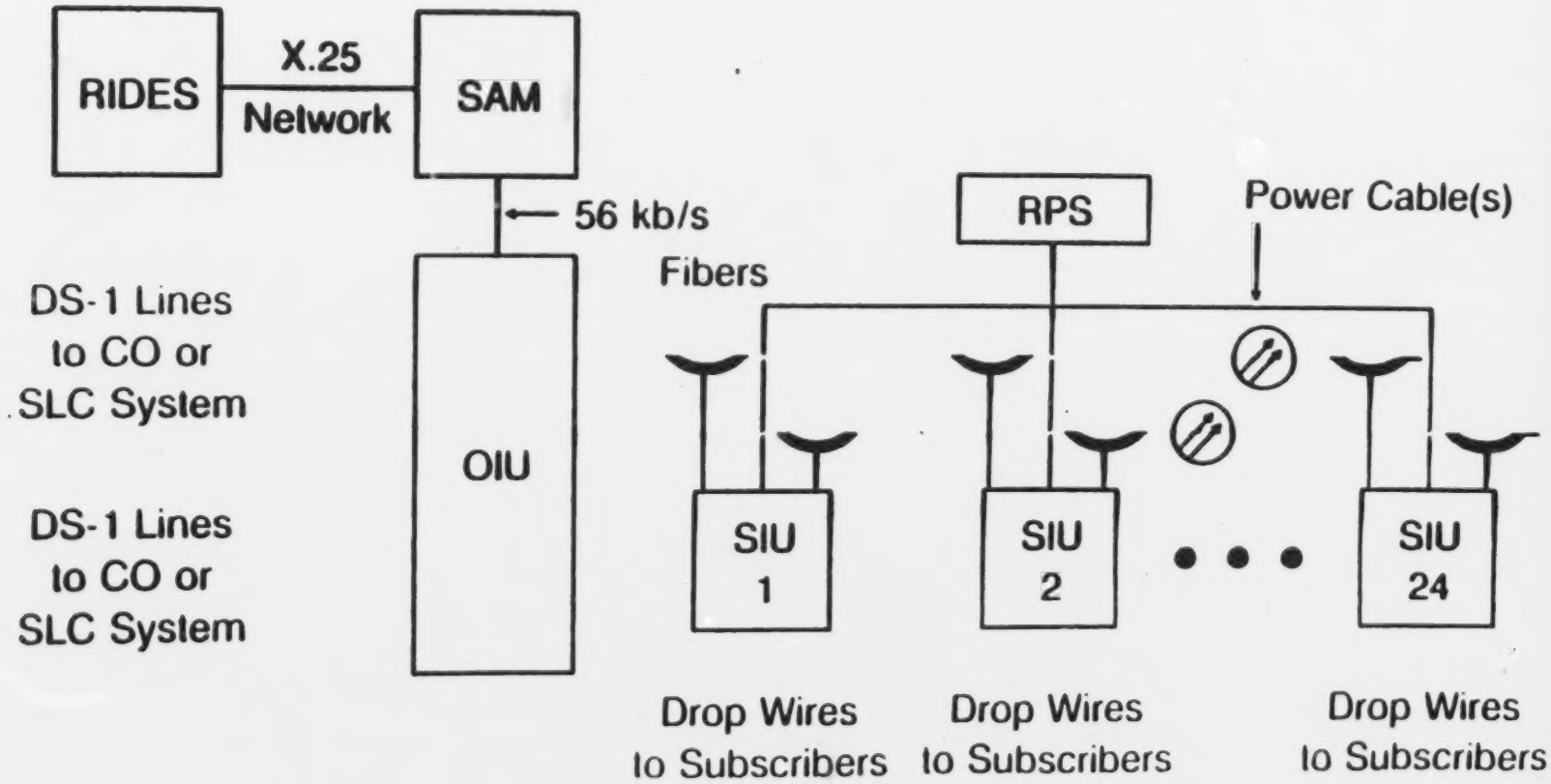


FIGURE 4

BROADBAND TECHNOLOGIES

Fiber-to-the-Curb

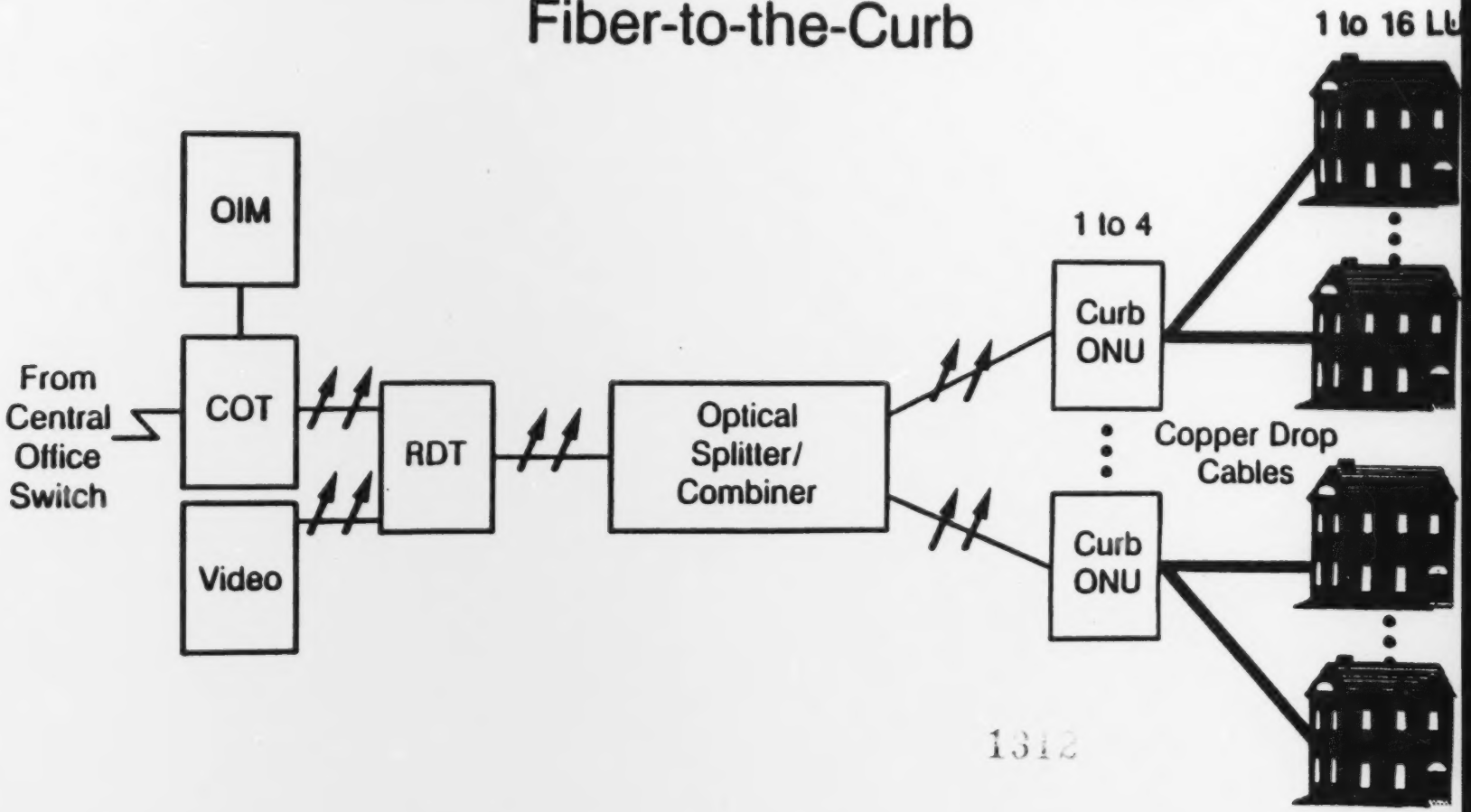
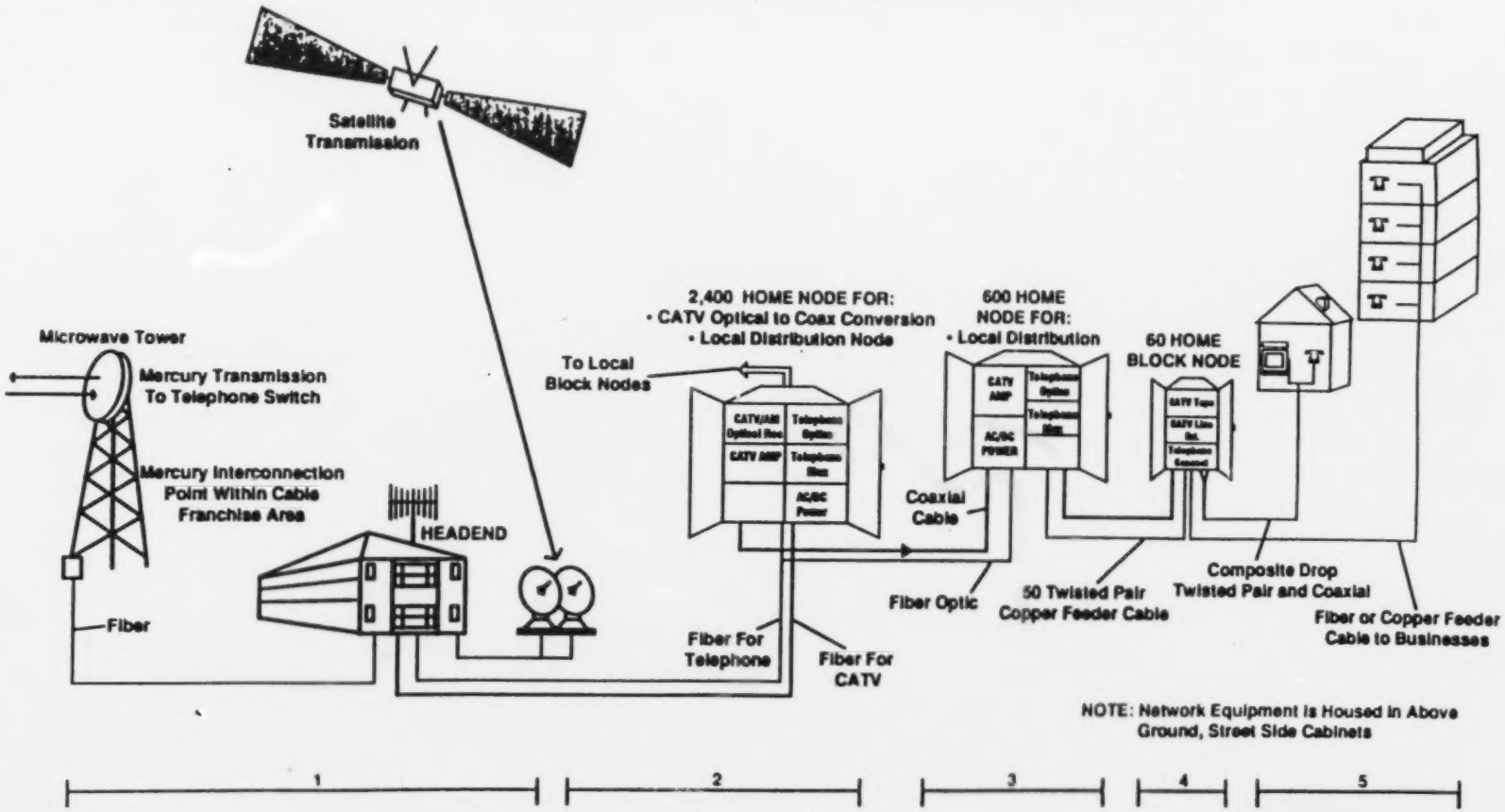


FIGURE 5

NYNEX CableComms

Integrated Cable Television & Telephone Network



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NYNEX-U.K.

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The COMSAT Model for Signatory Representation

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1. ABSTRACT

This article examines the essential features of the COMSAT model for Signatory representation, as it operates in the INTELSAT environment, and how that model has advanced overall U.S. commercial and national policy interests. The COMSAT model for Signatory representation has afforded numerous advantages and benefits within the U.S., which have facilitated the desired evolution of a competitive marketplace for the provision of satellite-based, international end-user services.

2. INTRODUCTION

2.1 Considerable attention has recently been focused on models for Signatory representation in international satellite organizations such as INTELSAT, INMARSAT and EUTELSAT, driven largely by worldwide trends towards privatization and deregulation. The U.S. has always had a privatized Signatory, Communications Satellite Corporation ("COMSAT"). The U.S. experience in this regard has been characterized by a level of competition in the satellite-based, international end-user services market far exceeding that achieved (or even contemplated) in any other country. The "COMSAT model" for Signatory representation has been a critical linchpin of this competitive environment, while simultaneously serving to maximize collective U.S. interests in the international satellite organizations in which the U.S. participates.

2.2 This article examines the essential features of the COMSAT model for Signatory representation, as it operates in the INTELSAT environment, and how that model has advanced overall U.S. commercial and national policy interests.

3. ESSENTIAL FEATURES OF THE COMSAT MODEL FOR SIGNATORY REPRESENTATION

3.1 The following constitute the essential features of the COMSAT model for Signatory representation as it presently exists in the United States:

- COMSAT, in its capacity as U.S. Signatory, is a private company, rather than a governmental entity, whose principal INTELSAT-related business activity is the provision of space segment resources, available on a nondiscriminatory basis to all U.S. carriers and users (collectively "U.S. operators").

- COMSAT is incentivized, principally through marketplace/ commercial forces (and, to a lesser degree, through regulatory oversight), to seek to maximize benefit of INTELSAT system for all U.S. operators at a reasonable cost.

- COMSAT has acquired extensive expertise in dealing with all phases of INTELSAT operations, upon which U.S. operators can call as they need assistance.

- COMSAT is fundamentally uninvolved in the domestic regulatory aspects of the provision of international end-user services in the U.S.

- The COMSAT model for Signatory representation has facilitated low-cost entry into the competitive telecommunications sector.

4. BENEFITS PROVIDED BY THE COMSAT MODEL FOR SIGNATORY REPRESENTATION TO U.S. COMMERCIAL INTERESTS

4.1 As a result of the COMSAT model for Signatory representation, a number of commercial advantages accrue to U.S. operators that access the INTELSAT system. These advantages include the following:

- COMSAT, through participation in the INTELSAT Board of Governors' activities, develops INTELSAT policies, programs, services and charges intended to benefit the interests of U.S. operators as a whole, and to be responsive to individual U.S. operators' requirements to the maximum extent possible.

- COMSAT seeks development of optimum operational plans to assure that maximum space segment capacity is available for all U.S. operators. COMSAT serves as the head of the U.S. Delegation at Operations Representatives ("Ops Reps") meetings, assures the establishment of coordinated (among all U.S. operators) U.S. positions on all operational matters considered at those meetings, and seeks approval at those meetings of the coordinated U.S. positions.

- COMSAT commits considerable resources and expertise to activities related to the planning and development of future system capacity in anticipation of expanding, shifting and evolving U.S. operator requirements.

- COMSAT maintains a network control center which is manned on a twenty-four-hour-per-day basis, thereby allowing for around-the-clock submission of and processing of service orders and activations, as well as trouble-shooting activities.

- COMSAT provides technical support and expertise for a number of developing countries and provides technical support through COMSAT Laboratories to advance satellite technology and knowledge, and to increase the quality and availability of international satellite communications.

- COMSAT actively participates in INTELSAT intersystem coordination matters involving all U.S. domsats and U.S.-registered separate systems, and has made available world-class technical resources to facilitate the successful completion of the technical aspects of such consultations. To date, there has not been a single U.S.-initiated intersystem coordination with INTELSAT that has not been successfully concluded.

- In crisis situations, such as the Persian Gulf situation, COMSAT has effectively served as a single interface point with INTELSAT to best represent collective U.S. interests in obtaining satellite services.

5. BENEFITS PROVIDED BY THE COMSAT MODEL FOR SIGNATORY REPRESENTATION TO U.S. NATIONAL POLICY INTERESTS

5.1 The COMSAT model for Signatory representation also provides a number of benefits to U.S. national policy interests, as they relate to

expanded availability of international telecommunications services generally to U.S. users. The advantages to U.S. national policy interests flowing from the COMSAT model for Signatory representation include the following:

- Maximization of total U.S. use of the INTELSAT system.

- Assurance that one U.S. operator does not attempt to thwart or discourage access or use of the INTELSAT system by another U.S. operator.

- Assurance of lowest prices to all U.S. operators by taking optimum advantage of INTELSAT bulk offerings now available under resource-based pricing and equitably sharing the benefits of these price breaks with all operators.

- Assurance that appropriate space segment resources are available and optimally configured to meet all U.S. requirements.

- Promotion of satellite technology over alternative media.

- Assurance that a low cost satellite option to facilitate market entry by new entrants is available.

- Encouragement to other Signatories to provide favorable access arrangements and operating agreements to all U.S.operators.

- Safeguarding of overall U.S. interests on a collective basis.

6. CONCLUSION

6.1 While circumstances vary from member country to member country within the INTELSAT arena, the COMSAT model for Signatory representation has afforded numerous advantages and benefits within the U.S., which have facilitated the desired evolution of a competitively-oriented international telecommunications marketplace. These advantages have enabled the U.S. successfully to promote the development of a competitive marketplace for the provision of satellite-based, international end-user services while avoiding a number of potential pitfalls that are currently being assessed in other countries with regard to the equitable, nondiscriminatory performance of the INTELSAT Signatory function.

PTC '92 - 'Video in the Pacific' Panel
13th January 1992
Honolulu

Opportunities for the Integration of Telecom and Video Distribution in Hong Kong

by
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Managing Director
The Wharf (Holdings) Limited, Hong Kong

Wharf

Wharf is one of the major public companies in Hong Kong. Our main businesses are property and franchised infrastructure, including terminals, transport and communications.

Wharf first became involved in Cable TV in 1988 when it joined a consortium to bid for a franchise in Hong Kong. The 5-member consortium was successful. However, as some of you will know, the other 4 consortium members subsequently voted not to continue with the project. That was in November 1990. Since that time Wharf has been working hard to win the franchise, hopefully later this year, that was handed back to the Government.

Television in Hong Kong

Currently Hong Kong has two terrestrial television stations offering a total of two channels in Cantonese and two in English. In addition 5 satellite television channels are licensed and broadcasting.

Telecom in Hong Kong

As the world's gateway to China, Hong Kong is a robust and dynamic place to do business. It is the regional centre for commerce, finance and services in Southeast Asia.

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Currently Hong Kong is undergoing a rapid transformation from a heavy dependence on manufacturing to a service centre. Its future prosperity is projected to rely on its service sector which provides over 65% of total GDP and employs over half of the work force.

As some of you already know, the telephone system in Hong Kong is operated by a private sector monopoly: the exclusive licence for domestic telephone services expires in 1995 and that for international telecom in 2006.

Hong Kong has 2.5 million telephone exchange lines and a total of 15,300 international circuits. The number of telephone sets in use, presently 3.1 million, is expected to increase by about 50% by the end of the century. International voice traffic, currently 1500 million minutes with gross revenue of about US$1 billion, is expected to grow by more than 20% each year and international data and fax by about 25%.

Demand for Competition

Although the present telephone infrastructure is advanced and adequate, monopoly means there exists little motivation for improvement. The trend towards a service based economy has made the transmission of information more vital. The customer is ready to go beyond basic telephone service into a more sophisticated telecom environment, in which choices may be made. As with any monopoly-provider environment, there exists a service gap between customer needs and services available.

In a financial community such as Hong Kong, excellent communications are crucial. The business community is crying out for more innovative and sophisticated telecom solutions. Many companies require unique solutions for their telecom problems which the existing service provider cannot or does not accommodate and many networking solutions offered by the telephone company are cost prohibitive.

Recent history in other countries has proven the success of second networks. Hong Kong too will benefit from competition in the local loop. In the competitive environment offered by the introduction of a second service provider, at a minimum the customer will benefit from price and service competition. The larger promise is that it may also bring innovation and a menu of new products and services.

Planning Considerations

With the imminent expiry of the exclusive licence for domestic telephone services any company installing a cable TV network must plan also for the eventual deregulation of telecom in 1995.

The evolution from a cable TV network to a telecom network is natural since the basic infrastructure will be in place. Given the existence of a suitably planned cable network, telecom can be added at a pace which is commensurate with the pace of deregulation and/or consumer demand.

A second network must be designed to meet the demands of the 21st century. This means that we must adopt a network architecture from the outset which will have the capability of evolving to one that can carry all types of signal, whether entertainment or telecom.

In co-operation with NYNEX, we have proposed to the Hong Kong Government a cable TV system delivered initially by microwave (MMDS) to the top of high rise buildings for local distribution by coaxial cable. This we see as a temporary measure to get the service up and running quickly and intend to replace MMDS as soon as possible with fibre.

Optical Fibre

Optical fibre is now the 'medium of choice' for telecom systems around the world, and many of the new services are fibre technology based: image transport, bulk data transport, multi-media services and video-conferencing.

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We have no doubt that a network installed today for a modern city has to be based on fibre. The network must also offer an evolutionary path from a purely television distribution network to one which will permit the integration of television and telecom as technology permits.

We are aware that in the last two years fibre-to-the-curb has become widely accepted in the US because it offers early cost parity with copper and provides increased savings in future years. The cost of upgrading the drop becomes quite manageable and can be done as broadband service needs arise. We have in Hong Kong the advantage that we are not planning an upgrade from copper but installing a completely new network based on fibre.

Integration of Telecom and Video Distribution

Historically cable companies and telecom companies operate distinctly different businesses. Although cable TV and telephone networks are inherently different now, they are both independently evolving step by step towards the same goal - a 2-way broadband network which can deliver bandwidth intensive services. Although not a universal view, analyses indicate that the cost of integrated delivery is less costly and of higher quality than separate delivery over today's independent networks.

In many respects the cable and telephone services appear similar to the consumer. Both services are delivered ubiquitously, both provide a way to communicate, both are delivered to the home through a jack on the wall and both services are perceived as basic necessities. With the convergence of cable and telecom we hope to be able to offer both services on our infrastructure in the longer term. A broadband network for cable TV means more channels and more services such as "pay-per-view" and "video-on-demand". In telecom it means a host of broadband switched services such as high speed switched data and multiple media services.

Video Applications

The appetite of consumers for information and entertainment is not expected to diminish. In fact, consumers will expect far more of their communications services as technologies continue to advance. We envisage a future where voice, data and video capabilities will all be interconnected. Consumers will be able to select and use various combinations of services according to their special needs, and at a time that is convenient to them. This customisation will give the consumer more flexibility and control than is available today. A broadband network based on fibre optic transmission is at the heart of this vision.

Switched digital video distribution will allow an exponential increase in the range of programme content available to the consumer. Just as telephone users can be connected to anyone else in the world who has access to a telephone, video switching will enable the user to have access to any programming service that is on the public network. The consumer can exercise a greater choice and control over viewing.

Fibre optic installations are opening up new dimensions in transmission services. Many opportunities will be opened up, limited, possibly, only by our imagination. For example:

Video-conferencing allows business people to reduce or eliminate their travel time. It is currently available in Hong Kong on an as required basis. The fibre based network we envisage would make it readily available. Once it is readily available not only will it be used by businesses, it will also provide a realistic alternative to school or university learning for people who cannot attend class.

There are also benefits to industry. In particular for Hong Kong, transmission of mixed text, pictures and data will be of extreme value to the many companies involved in publishing. Complete or partial magazines, books and so on can be produced in electronic format in one location and printed in another. This capability has revolutionised the newspaper industry in many parts of the world, most dramatically perhaps in the UK.

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Health care is another obvious and very important use.

One area of concern in Hong Kong is the shortage and high cost of providing medical facilities. The introduction of 'Enhanced Image Technology', similar to that offered by NYNEX in Boston, would help alleviate the problem.

At present there are, for example, a limited number of CAT scanners and MR imagers in Hong Kong, which are needed for diagnosing certain illnesses. This means that doctors have to travel across Hong Kong in order to be present when their patients require these facilities. Provision of high resolution medical imaging would mean that doctors could save time by having a display in their office and view results remotely. It would be possible for other specialists to give a second opinion without having to leave their own offices. In this way major hospitals can pool their facilities and share expensive and scarce medical expertise.

Conclusion

Today, digital switched video is not at the stage of development where it can supersede today's broadcast video systems. But in the not-so-distant future, advances in technologies combined with cost reduction in broadband switching, multiplexing and digital electronics will allow the evolution of an integrated network which can deliver digital video, voice and data to masses of customers.

We believe that consumers will be eager to embrace these new services and advanced technologies. The talents and energies of many businesses and organisations may be realised to their full potential by utilisation of these new services.

There is a well documented list of factors taken into account by multi-national organisations when they decide whether or not to set up a base in any given country. Well developed telecom is a priority factor on most lists. Not only good business telecom but

also residential. We are in a global market. Decision makers in major corporations because of different time zones frequently need to communicate with others from their home.

Once good telecom is available readily and economically at home they will soon be seen as essential Perhaps in a few years time more and more businessmen and women will operate from an office in their home.

Video encompasses all types of visual information which can be transported over a broadband fibre network. The use of fibre is a central ingredient in the evolutionary trend of a future switched video system. Whatever the future we plan to build a fibre network to keep Hong Kong as a leading world financial and trading centre into the next century.

At this time the opportunity for building and operating a second network is good, based on customer needs and the technologies available to meet them. A fibre network brought very close to the home, is the essential element in the broadband network of the future. From a Hong Kong perspective, the time is now to exploit this readily available technology to construct a superior network providing switched broadband services and maximise the tremendous opportunities that it will provide.

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HDTV and Satellite Broadcasting in Japan

PTC'92

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HDTV in Japan

1. History of the development of HDTV in Japan
2. Features of HDTV
3. Present state of HDTV technology
4. Establishment of HDTV standards
5. HDTV satellite broadcasting
6. Development of home use receivers
7. HDTV program production
8. Non-broadcast applications of HDTV
9. Exposure of HDTV to general public
10. Promotion activities of introduction of HDTV
11. Future of HDTV

History of the development of HDTV in Japan

1970: Development of experimental black & white camera
1972: Proposal to set up a new Study Program for HDTV to CCIR
1974: Development of experimental color camera
1975: Development of HLO-PAL transmission system
1978: Experimental satellite transmission of HDTV signals using 2 channels for luminance and chrominance signals
1981: Development of MUSE satellite broadcasting system
1985: Demonstration in Tsukuba Expo'85 including MUSE terrestrial transmission and 400-inch large screen projector
1986: Development of digital VTR
1986: First Experimental satellite transmission of MUSE signals
1987: Establishment of BTA studio standard (S-001)
1987: Development of HARP pich-up tube
1988: Development of UNIHI VCR
1988: International transmission of MUSE signals from Japan to Australia
1988: Transmission of Olympic games from Seoul, Korea to Japan
1989: Start of daily one-hour HDTV experimental satellite broadcasting
1990: Adoption of CCIR recommendation for studio standard
1990: Development of MUSE receivers using MUSE decoder LSIs chips
1991: Establishment of the standard for satellite broadcasting based on MUSE system

Feature of HDTV

1.	Wide aspect ratio	16:9
2.	Large screen	50-inch or larger in diagonal
3.	High resolution	Twice of standard TV in both vertical and horizontal directions (active 1035-line x 1920-sample)
4.	High quality color reproduction	
5.	Viewing distance	3 times of picture height
6.	Multi-channel audio	Rear 3 speakers Front 2 speakers
7.	Wide application capability for industrial uses	

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Present state of HDTV technology

1. Camera
   - High sensitivity HARP camera
   - CCD camera (2-million and1.3-million picture elements)
2. VTR
   - 1-inch open reel digital VTR
   - 1/2-inch cassette analog VTR
3. Switcher and special effect equipment
4. Standard converter
   - HDTV to NTSC
   - HDTV to PAL and SECAM
   - HDTV to Film
5. Transmission equipment
   - FPU (Field pick up unit)
   - Satellite transmission equipment
   - Digital transmission equipment
6. OB-van
7. Display
   - CRT display (32, 36 and 40-inch)
   - Rear projection display(50-inch ~)
   - Front projection display(100-inch ~)
   - Liquid crystal projection display
   - Plasma display(40-inch)
8. Broadcasting system
   - MUSE encoder
   - MUSE home receiver
   - MUSE home VCR and Disk
9. Other equipment and systems for industrial uses

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Establishment of HDTV broadcasting standards

1. Provisional studio standard used for Tsukuba Expo'85

   Scanning : 1125/60 and 5 t0 3 aspect ratio

2. BTA S-001 Standard

   Established by BTA (Broadcast Technology Association) in August 1987

   Scanning : 1125/60 and 16 to 9 aspect ratio

   Same parameter valuse with SMPTE 240M standard

3. National Standard for HDTV satellite Broadcasting

   Established in March 1991

   Based on the recommendations made by CCIR and the Telecommunication Technology Council (Japan)

   Studio standard : 1125/60 and 16 to 9 aspect ratio
   Emission standard : MUSE system

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HDTV Satellite Broadcasting

1. Daily 1-hour experimental broadcasting

(1) Operator : NHK

(2) Started in June 1989 using BS-3a

(3) Receiving site : more than 100 sites all over Japan

(Public spaces and department stores etc.)

2. Daily 8-hour test broadcasting

(1) Operator : Hivision Promotion Association
(Members : NHK and commercial broadcasters, production, manufacturers and others)

(2) Started on November 25, 1991

(3) One of three transponders of BS-3b is used exclusively for this broadcasting

(4) 4 hours are used for NHK programs and other 4 hours are used for programs produced by other broadcasters and program providers

Development of HDTV Receiver

1. Development of MUSE decoder using discrete-type ICs

(1) 11 manufactures developed MUSE decoders

(2) Started in April 1987 and finished in March 1990

2. Development of the first generation MUSE LSIs

(1) 6 manufacturers jointly worked with NHK for the development of MUSE LSIs

(2) 25 different type LSIs were developed in 1989

(3) MUSE decoders using LSIs were on the market in December 1990 and early 1991

3. Development of the second generation MUSE LSIs

(1) About 10 different kinds of highly integrated LSIs for a MUSE decoder

(2) Three different groups of manufacturers have been established for the development of 2nd generation LSIs

(3) Target date of the development is between 1992 and 1993

4. Consumer use VCR and Video Disk

(1) Several manufacturers agreed on the specification for HDTV VCR (Component signal type)

(2) Several manufacturers agreed on the specification for MUSE Laser Disk

HDTV Program Production

1. More than 600 programs have been produced using the 1125/60 system

2. Cost saving for the HDTV program production is essential

(1) International co-production of HDTV programs

(2) Use of HDTV programs for NTSC broadcasting

(3) Multi-media application of HDTV programs
Package, publication etc

Non-Broadcast Application of HDTV

1. Application areas

(1) Printing and publication

(2) Movie production

(3) Medical field

(4) Video theater

(5) Image processing

(6) Telecommunication

(7) Video data base

2. Estimation of market size of HDTV (by MPT and MITI in 1987)

Broadcasting : 3300 billion Yen (in the year 2000)

Indusrial use : 930 billion Yen (in the year 2000)

Exposure of HDTV to General Public

1. Objectives

(1) Better understanding of HDTV by general public

(2) Development of good and reliable equipment by manufacturers

2. Examples of large scale demonstration

(1) Tsukuba Science Expo'85 (1985)
MUSE terrestrial Broadcasting
400-inch large display theater

(2) Nara Silk-road Expo to Brisbane (Australia) Leisure Expo'88(1988)
3-hop transmission of HDTV signals using communications satellites(CS, Intelsat and Ausat)

(3) Seoul Olympic Games(1988)
HDTV satellite broadcasting of the opening and closing ceremonies of the Olympic Games(2-hop transmission)

(4) Osaka Flora Expo'90(1990)
Distribution of Expo HDTV programs to over 100 demonstration sites all over Japan

(5) Annual Hi-Vision Week(November 25 - 1125)
Special demonstration of HDTV

Promotion Activities of Introduction of HDTV

1. Hi-Vision City Project

(1) Project of the Ministry of Post and Telecommunication

(2) 24 cities have been appointed as Hi-Vision Cities

(3) Hi-Vison theater, Hi-Vision data base and Hi-Vision CAD/CAM will be introdused

2. Hi-Vision Community Project

(1) Project of the Ministry of International Trade and industries

(2) 19 cities have been appointed as Hi-Vision Communities

(3) Hi-Vision theater, Hi-Vision Art Museum and Hi-Vision data base

3. Hi-Vision Museum Project

(1) Project of the Autonomy Ministry

(2) More than 30 cities are appointed

(3) Hi-Vision Museum will be introdused using Hi-Vision still picture system recently standardized by HVC (Hi-Vision Promotion Center backed by MITI)

Future of HDTV

1. Digital HDTV broadcasting

(1) Analog HDTV Broadcasting (MUSE) using 12 GHz band

(2) Digital HDTV Broadcasting using 17~25 GHz band

(3) Integrated Service Digital Broadcasting
Family of services using 17~25GHz band, 12GHz and 1.5~2.5GHz bands

2. Stereoscopic (3D) broadcasting

(1) Much higher quality and reality than HDTV for picture and sound

(2) 3D display without using glasses

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Satellite Broadcasting in Japan

1. Present state of satellite broadcasting in Japan

2. Broadcasting service via communications satellites

3. Future of satellite broadcasting in Japan

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Present state of satellite Broadcasting in Japan

BS-3a

CH-7	Operator	: NHK
	System	: Digital Sub-carrier NTSC
	Service	: 24-hour
	Program	: World news and sports
CH-11	Operator	: NHK
	System	: Digital Sub-carrier NTSC
	Service	: 24-hour
	Program	: Entertainment and culture

BS-3b

CH-5	Operator	: JSB
	System	: Digital sub-carrier NTSC with scramble
	Service	: 24-hour
	Program	: Movie and entertainment
CH-9	Operator	: Hivision Promotion Association
	System	: HDTV (MUSE)
	Service	: 8-hour
	Program	: Entertainment, culture and sports

Future of Satellite Broadcasting Service in Japan

1. Schedule for launching of new satellites

(1) Broadcasting satellite

BS-4 (Post BS-3) (1997)

(2) Communications satellite

Super Bird-B	(Feb. 1992)
Super Bird-A	(Dec. 1992)
SJC-1	(Jun. 1994)
SJC-2	(Dec. 1994)
Post JCSAT	(1999)

(3) Experimental satellite for broadcasting and communication

COMETS	(1997)
COMETS-II	(1999)

2. New satellite broadcasting service

(1) Data broadcasting using digital data channel of NTSC satellite broadcasting (480Kb/s)

(2) ISDB (Integrated Service Digital Broadcasting)

- 17~25GHz band ISDN (~150Mb/s)
- 12GHz band ISDN (~40Mb/s)
- 1.5~2.5GHz band ISDN (~6Mb/s)
- Terrestrial UHF/VHF ISDN (~25Mb/s)

Broadcasting Service via Communications Satellite

1. Television service (Service to be started after April 1992)

(1) Super Bird B (To be launched in Feburary 1992)

- Nippon Cable Televisin
- Star Channel
- Music Television

(2) JC-SAT 2

- Space Shower
- Japan Sports Channel
- Eisei Eiga Engeki Housou

2. Digital sound service (Service to be started after April 1992)

(1) Super Bird B (To be launched in Feburary 1992)

- Space Sound Tokyo
- PCM Japan

(2) JC-SAT 2

- Satellite MUsic
- Music Bird
- PCM Zippang Communications
- Nippon Music Congress

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BISDN STANDARDS IN THE US AND JAPAN

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ABSTRACT: This paper investigates differences in the pursuit of BISDN standards in the United States and Japan. The hypothesis is that cultural and structural differences in the two nations have led to different assumptions and the setting of different priorities in the telecommunications standards arena. These differences at the national level result in difficulty at the international level as participants enter the international arena with differing conceptions of the values at stake.
KEYWORDS: BISDN; Telecommunication Standards; United States; Japan

Introduction

Critical political and structural differences exist between Japan and the U.S. with regards to their telecommunication industries. One area in which the differences have been quite marked is in the area of telecommunication standards. The processes by which telecommunication standards are agreed domestically -- and are pursued internationally -- in the two nations are quite different. These differences will be briefly reviewed here. The developments in BISDN standards will be used as an example.

The Setting of Japanese Telecommunication Standards

In the context of rapidly converging telecommunication and information technologies, the first key point to be made in describing the Japanese situation is that there is a division of responsibility between the MPT (Ministry of Posts and Telecommunication) and MITI (Ministry of International Trade and Industry). A gross simplification of the division is that MPT is responsible for telecommunication network standards and MITI is responsible for information systems equipment standards. On each side of this division the ministries are technically and officially responsible for the standards processes and publish the standards which are ultimately agreed. In each ministry the work of negotiating

[illegible] the output of these groups is advisory to the State Department and to its appointed delegations to the proceedings of the CCITT.

Because they cannot consider such matters as potentially conflictive with US national or international policy, national security, or enforcement for the US at international meetings, the US National CCITT Committee's conclusions are not binding on the delegations' discussions of contributions to the CCITT. Because of the emphasis on parallelism and participation in the US and because of the advisory nature of the US National CCITT Committee, normally the US CCITT Committee would wait for substantial agreement to have been achieved in TI before attempting to agree on a contribution to the CCITT. The proceedings of the TI Working Groups are considered the appropriate forum for the consideration of objections and for the debate over the wordings of documents. On the other hand, it is also normal for TI to work closely with the US CCITT Committee and to delay sending any draft standard to ANSI for recognition as an American National Standard until after the work of the CCITT on the issue. This delay is a recognition that deliberations at the CCITT, agreed to by the State Department's delegation, may substantially differ from the agreements reached at TI and may require reconsideration of the issue.

With regard to the division of authority over standards in the network and standards in the terminal equipment areas, there are other standards setting institutions in the US including the Institute of Electrical and Electronic Engineers and the Electronic Industry Association, among others. Unlike the Japanese case, however, there is considerable formal as well as informal liaison between the TI Working Groups and each of these other organizations in order to avoid duplication of effort and potential conflicts. Since all of this work falls in the private sector and largely concerns the code files, there is no comparable division of authority between ministerial bureaucrats, nor any justification for a failure to coordinate.

[illegible] BISDN STANDARDS

In using BISDN as an example of the differences in standards governance in the US and in Japan, the proper focus is on the way the two nations have reached domestic agreements and then have participated at the international level in the movement toward international standards. There have been a great many issues with regard to BISDN about which there have been differences along national lines. Two issues stand out as especially interesting:

a) SDH (SONET) frame format

system the structure not only allows but demands enormous input from a broad range of interested parties. But on the issues of a new technology like BISDN, one representative of one company can come to dominate the US contribution and the negotiation of the US position at the CCITT. Again, the causes of such a situation are both cultural and structural.

a) SDH (SONET) frame format

At the Hamburg meeting of Study Group XVIII in May of 1987, the US delegation tentatively gave up the US position of 13 rows of 180 octets and agreed to accept an SDH frame format of nine rows of 270 octets. Their position, however, was that they had no power to give up on the 13 row agreement which had come out of Committee T1, and would have to send the matter back to T1 for authorization. This frustrated the Japanese and European (especially British) delegations, which have the authority to negotiate for their countries. Two changes in the US participation at CCITT have since come about. First, T1 has begun to delay final consideration of any standard pending CCITT resolution. This recognizes the increasing importance of international standards to US manufacturers. Whereas at one time the US was a telecommunication island with little concern for global standardization, the market is now a global one and both US manufacturers and US carriers want global standards. In addition, US delegation meetings are held every morning at the CCITT and in some cases the attendance at these meetings includes virtually all of the interested and active members of the T1 working group responsible for the issue under consideration. This allows for some certainty that compromises negotiated at CCITT will be assured support at T1.

b) ATM payload type 2 - real time variable bit rate

NTT's view of the Japanese market for switched broadband services is heavily oriented towards video applications. Under the marketing label of Visual, Intelligent & Personal Services (VI&P), NTT plans a variety of services which will require the ATM type 2 - variable bit rate payload. For this reason, there has been considerable work at NTT on defining this transmission type. In the US, however, there are many competing visions of how video images can best be digitally coded and compressed for transmission. While some of the methods involve variable bit rates, many are continuous bit rate services. With little clarity on what will come out of the codec, there is little interest in the US on standardizing what will be carried through

STANDARD STRATEGIES - KEY TO PROFIT OR LOSS?

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1.0 ABSTRACT

This paper will discuss the strategic impact of standards development upon business success. The primary objective is to establish a linkage between evolving standards, the need for direct involvement, the resources, and the overall goals of the business. There will be several examples, and the paper will include information on the standards development organizations with an emphasis on telecommunications. The trend toward a global outlook in various standards development groups will be emphasized.

2.0 INTRODUCTION

Industry standards are the cornerstone for underlying technologies, networks, network elements, and services found in a companies network evolution or expansion plan. In the telecommunications industry, recent standards development trends in networking have facilitated the exchange of global information, and have improved the consistency of network interfaces. The overall impact has contributed to the communications infrastructure, and has been the basis for initiating global synergy between national communications networks. Examples of these trends are the evolution of international SONET standards, implementation of ISDN standards, the evolution to broadband ISDN, the worldwide development of Electronic Data Interchange standards, the developing standards for Universal Personal Telecommunications, and the Intelligent Network.

As detailed in subsequent sections, standards have a significant impact on a business entities ability to meet its strategic objectives. In addition, many of the services planned for introduction into communications networks will never work uniformly or on a national scale (or international scale) without the application of both national and/or international standards. It is therefore essential for business, at a time when globalization of the telecommunications market is taking place, to implement standards strategic plans based on corporate goals to assure the technical interoperability of a telecommunications network within local, national and international networks. Standards provide the foundation for confidence to network users and suppliers that all of the pieces needed to provide services will be compatible with each other's end-to-end network. Direct involvement in standards fora will enable economies in equipment acquisition operational costs, and significant opportunities in the offering of comparable services ubiquitously.

However, the key to using standards development as a strategic planning tool with an eye to improving the bottom line is direct participation in the development process. Unfortunately, very few if any businesses could reasonably afford the cost of broad base participation, specifically the cost of membership plus associated travel and the commitment of technical resources. In order to assure efficient use of technical experts to participate in standards development, the process should be managed to enable a select number of representatives to participate in key standards fora on a regular basis. These participants should be authorized to make standards development decisions, or agree to compromises at the working level. The representatives usually would be supported during the preparation of technical contributions by subject matter experts from a technical support organization (R&D; etc.). Planners, who could also be direct participants, should interact with R&D, manufacturing, and marketing to facilitate and ensure that the overall standards development is aligned with a common business goal.

3.0 OVERVIEW OF STANDARDS

The International Telecommunication Union (ITU), created in 1866 and now a specialized organization of the United Nations, is a key international organization for developing global agreements pertaining to the development of telecommunications standards. Per its charter, the purpose of the ITU is to maintain and extend international cooperation for the improvement and use of international telecommunications, and to promote the development of technical facilities with an emphasis on improving the efficiency, availability and effectiveness of telecommunications services, and to harmonize the actions of nations to achieve those results for the benefit of the general public. Membership in the ITU is by nation. Membership in the CCITT (International Consultative Committee on Telephone and Telegraph) and CCIR (International Consultative Committee on Radio) , the two technical organs of the ITU, is by Administrations, by Recognized Private Operating Agencies, and Scientific and Industrial Organizations. CCITT and CCIR are the key standards developing units within the ITU. CCITT develops recommendations for telecommunications. While countries are not legally bound by treaty to apply CCITT standards recommendations, they are encouraged to do so.

CCITT recommendations fall into two overall classes as follows: End-to-End standards, which cover the networks and the network terminals (not CPE), and both ends, and interface standards to enable customer premise terminals to interconnect into the regulated network. These recommendations have been published on a four year cycle and have been identified by the color of the binder. For example in 1984, the cover color was red, in 1988 blue, and in 1992 white. Beginning in 1993, recommendations will be published separately as soon as they are approved by the CCITT. United States participation is through the U.S. State Department via an organization officially designated the U.S. CCITT

(United States Organization for the International Telegraph and Telephone Consultative Committee). The public and private telecommunications sectors are encouraged by the State Department to meet and develop a United States position on all recommendations, and both sectors are further encouraged to participate directly in CCITT technical study groups (and related sub technical groups) to work on recommendations from the very beginning of the development process.

The U.S. standards telecommunications development process generally operates under the American National Standards Institute (ANSI) Guidelines, which require openness, balance, consensus, and due process in all phases of the standards development cycle. ANSI is a private, non-profit membership organization that coordinates the United States voluntary consensus standards system and approves American National Standards. It is also the U.S. representative and dues paying member of two non-treaty international standards organizations: the International Organization for Standardization (ISO) and the International Electrotechnical Committee (IEC) via the U.S. National Committee (USNC). ANSI membership consists of approximately 1,100 companies, 230 professional, technical, trade labor and consumer organizations, and 30 government agencies.

Prior to the divestiture agreement, which broke up the American Telephone and Telegraph Company (usually referred to as the Bell System), Bell System technical standards provided the specifications necessary for the national telephone network to operate in an integrated fashion. This effort was in cooperation with the United States Independent Telephone Association. One popular reference was entitled "Notes on the Network". (Note: A similar publication is currently published by Bellcore entitled, "BOC Notes on the LEC Networks-1990", Special Report SR-TSV-002275, Issue 1, March 1991.) With divestiture, there arose a need for an organization to carry out the network integration functions. The Exchange Carriers Association (ECSA) was established to promote the timely resolution of national and international issues involving telecommunications standards and the development of telecommunications operational guidelines. To accomplish this task ECSA sponsors the following committees:

- Standards Committee T1-Telecommunications: develops standards and technical reports related to interfaces for the United States telecommunications network, and develops positions related to telecommunications networks for presentation at international standards development fora.

- Carrier Liaison Committee: is an inter-industry organization, endorsed by the Federal Communications Commission, for discussion and voluntary resolution of nationwide concerns about the provisioning of exchange access service.

- Telecommunications Industry Forum: provides the guidelines for the electronic transfer of data over the network, and for the electronic transfer of telephone company customer billing based on Electronic Data Interchange (EDI) standards developed in ANSI Committee X12.

- Information Industry Liaison Committee: handles technical operational, and administrative issues associated with Open Network Architecture (ONA).

- Protection Engineers Group: provides for the discussion and development of standards contributions to ANSI accredited fora on electrical protection of exchange carrier facilities.

- Accredited Standards Committee 05: develops telecommunications standards for the telecommunications industry in technical areas dealing with wood poles and other wood products.

Committee T1 is accredited by ANSI and is the focal point for the development of telecommunications network interface standards. The work process is based upon ANSI Guidelines, specifically, on the ANSI "Style Manual for Preparation of Proposed American National Standards" and "The Procedures for the Development and Coordination of American National Standards". The objective is to publish standards with a broad consensus of support, usually unanimity. There are about 90 members in T1 representing Local Exchange Carriers, Inter-Exchange Carriers, Manufacturers (mostly U.S.), the U.S. government, Users of Telecommunications Services, and Others. Participation in standards development is open to anyone materially interested, and voting membership is easily obtainable by any interested service provider, manufacturer, user of services, or government agency, etc. Committee T1 is comprised of seven Technical Subcommittees (TSCs), which are further subdivided into working groups. These TSC working groups meet on a regular basis to develop standards that directly or indirectly affect communications networks. Because more manufacturers are developing equipment manufactured for global markets, cooperation and exchange of information between T1 and the CCITT has been the norm rather than the exception. In addition, there has been some limited cooperation between Committee T1 and the European Telecommunications Standards Institute (ETSI). Presently this work is being encouraged through regional meetings attended by Committee T1, CCITT, CCIR, ETSI and the Telecommunications Technology Council (TTC) of Japan. These meetings are known as the Interregional Telecommunications Standards Conferences. Key standards, which begin at CCITT, are often brought to T1 for comment or review to assure global compatibility. Conversely, T1 standards are submitted to CCITT as contributions via U.S. State Department Study Groups for the same reason. There are other organizations in the United States such as the Institute of Electrical and Electronic Engineers (IEEE), the Telecommunications Industry Association (TIA), the Corporation for Open Systems (COS), and the Cellular Telecommunications Industry Association (CTIA) to name a few, which also develop standards and contribute to the work of CCITT.

Another influential factor in the area of standards development both in the United States and internationally is the Bellcore Technical Analysis (TA)/Technical Requirement (TR) process. In practice, the TA/TRs and T1 standards feed into each other. Bellcore's TA/TR writers draw from both draft and finished standards. Often the TA/TR writers participate in the development of the standards. In general, the development of a TA/TR is faster and often helps to speed up standards

development. However, TA/TRs are technical analysis or requirements documents developed by Bellcore for the Bell Client Companies (regions) and do not have the industry and regulatory body acceptance of ANSI accredited industry standards. Often TA/TRs that have undergone industry scrutiny through the standards process become the basis for standards, which are often identical to the original TA/TR. A broad goal of Bellcore and the BCCs generally has been to work toward aligning TA/TRs with evolving standards.

Currently in the United States, there are telecommunications standards being developed for customer-to-network interfaces, network-to-network interfaces, services and architecture, switch to computer applications, intelligent networks, personal communications, network performance, network maintenance and many others.

4.0 BENEFITS OF STANDARDS

Standards serve the vital function of detailing the technical nature of telecommunications network interfaces and operations systems, thus ensuring proper interworking among the various elements of a modern network, including maintenance/operational systems. In addition, standards fora provide representatives unique opportunities to meet with other industry participants, gain insight into their telecommunications planning and obtain a level of both practical and technical network knowledge not available through any other industry association.

For a corporation, participation in the standards development process results in benefits as well as some risks. Examples of benefits are as follows:

- reduced equipment costs, by making network elements interchangeable and thereby inducing competition among vendors;
- vendor independence, by making equipment available from more than one vendor;
- economies of scale in the manufacturing and implementing of new network technologies, thus reducing costs and service providers rates;
- services and features transparency, thus ensuring that services will work the same way, regardless of the equipment used, or service provider;
- a source of competitive information;
- an enhanced corporate domestic and global image as a leader in telecommunication network development is acquired through visible and effective participation in standards fora;
- ensures that standards beneficial to corporations strategic business needs are developed through technical contributions, analysis of others' contributions, and efforts to develop industry consensus;
- provides a vital element for a companies Quality Program requirements for planning and implementing its future network architecture.

The risks are that standards could be adopted which are unfavorable to corporate business interests, that hamper the ability to meet the needs of customers or that delay the introduction of a service that has a finite market window. Obviously, all of these risks are associated with an economic penalty.

The key function of corporate standards strategic planners and representatives is to ensure that the standards developed are in harmony with network evolution and long term strategic business goals. Without effective participation and a strong voice, the other major industry players (who probably are competitors) may to a great degree determine how the telecommunications network will evolve, which may have a serious impact on overall competitiveness, the ability to increase revenues and conversely reduce operating and equipment costs.

4.1 Examples of standards activities in key technical areas

Below are *some* examples of standards issues related to Personal Communications Systems (PCS), Broadband Integrated Services Digital Network (B-ISDN), Switch-to-Computer Applications Interface (SCAI) and Universal Personal Telecommunications (UPT). These are presented here to provide the reader with an appreciation for the business implications resulting from the standards development process.

4.1.1 Personal Communications Systems

PCS are defined as systems that will provide a broad range of new communications services that will free individuals from the constraints of the wireline telephone network. With PCS, customers will be able to make or receive calls, regardless of physical location; home, office, train, etc., or another city/country.

The two major components necessary for full PCS are: (a) wireless access; and, (b) Intelligent Network (IN) functionalities. Wireless access will provide customers with a tetherless connection to the network enabling them to gain mobility. IN capabilities will provide networks with the intelligence to know where customers are located, how calls should be routed, whether customers attempting to initiate calls are authorized to do so, and how calls should be billed. With both components present, customers can initiate or receive calls anywhere in a home, office, train, plane, hotel, another city or another country.

PCS issues are being addressed by standards and/or regulatory bodies. Examples are as follows: new spectrum allocation, license eligibility, spectrum use, wireless access technology, and PCS numbering. Internationally, PCS standards are being developed in CCITT and CCIR under the designation Universal Personal Telecommunications (UPT) and Future Public Land Mobile Telecommunications Systems (FPLMTS). In the United States, PCS interface standards are being developed within Committee T1 with the cooperation of the Telephone Industry Association (TIA).

4.1.2 Broadband Integrated Services Digital Network (BISDN)

The U.S. standard for B-ISDN is being developed in Committee T1 technical subcommittees T1S1 and T1E1 and will be aligned with the standard being developed in the CCITT. This standard incorporates Asynchronous Transfer Mode (ATM) switching techniques and an ATM Adaptation Layer (AAL) for support services, which is connection oriented. The Institute of Electrical and Electronics Engineers (IEEE) 802.6 standards technical subcommittee on high speed connectionless data services approved a standard (December 1990) that defines a connectionless data transfer using a Distributed Queue Dual Bus (DQDB) interface for broadband services to be offered on Metropolitan Area Networks (MANs). This DQDB protocol forms the basis for an access protocol to a Switched Multimegabit Data Service (SMDS). The issue facing the standards bodies is one of compatibility, specifically between the IEEE 802.6 DQDB interface and the CCITT/T1 ATM/B-ISDN interface. Generally companies have encouraged the development of technical solutions to minimize the differences between the IEEE 802.6 DQDB interface and the CCITT/T1 B-ISDN/ATM interface to ensure a smooth migration to a B-ISDN network. This standards effort is being worked and probably has a high priority in company standards development strategy, in view of the evolution to a broadband network.

4.1.3 Switch-to-Computer Applications Interface (SCAI)

SCAI will provide the protocol and control mechanisms that will enable the definition and development of applications requiring the intelligent interaction between computers and either PBXs or central office switches. At issue in standards development fora, is the extent of alignment between a PBX computer and a central office computer interface.

SCAI has also been proposed as the application interface used to access the Service Node (SN), a subset of the Service Control Point. The SN is a network element identified in the Advanced Intelligent Network (AIN) Release 1 architecture. The SN may be used to provide advanced services. However, controversy surrounds the use of SCAI as the interface, and whether the SCAI standard will be completed in time for AIN Release 1, which is scheduled for deployment in the 1994-95 time frame.

Usually a regulated telecommunications standards planning strategy would support the development of a SCAI standard to provide a common platform for uniformly exchanging application process information between the telecommunications and data processing environments. Lack of a standard SCAI interface or other comparable interface could cause some customers of a telephone network services provider to request direct connectivity to a common signaling network, such as Signaling System Number 7 in the United States to access advanced call processing functions. SCAI provides access to these functions without the need for customer-to-SS7 direct connectivity. There is concern in some quarters that direct access to a network signaling system could cause network problems. (Note: In standards fora the rash of recent United States telephone network blackouts has resulted in considerable discussion on this question of direct access. Also of concern is the experience of data and computer systems and networks with virus infections, and unauthorized intrusion into communications networks and network elements.) The SCAI standard is being developed in the T1S1.1 working group (Architecture and Services). The group's objective is to define a method for uniformly exchanging application process information between the telecommunications and data processing environments.

4.1.4 Universal Personal Telecommunications Numbering

The broad goal of Universal Personal Telecommunications (UPT) standards development is to provide for communications services to (and from) a person rather than to (and from) a specific location, thus stretching personal mobility as well as terminal mobility. The transmission path used to transport this service may use wireless technology or wired technology and may be regulated or unregulated. As a result, a unique personal address (number) identifying a person rather than a location with an associated data base is desired. At issue, is the standard structure of the address, its relationship to the service provider's network, and the administration of the number data base. Other issues concern portability of numbers, simplicity, and the evolution to a personal number not based on geography.

The numbering question is being discussed in CCITT Study Group II. One camp feels that the present numbering arrangements are adequate. Another proposal is for a plan based on using a prefix of up to three digits prior to a personal number to identify a UPT call. At issue is the economic penalty which will probably be incurred by the operators of telephone networks to handle the potential of a longer address to terminate a call, and its subsequent effect on a future intelligent network data base.

5.0 CONCLUSIONS

In order for a business entity to be effective in ensuring that evolving standards are consistent with strategic network plans, it must be prepared to commit the technical and planning resources required to support strategic network business goals in an ever-accelerating development of software and protocol related services. The number of services that require standardized protocol and procedures is a direct function of the explosive growth in computer processing power and the growing use of computer to computer communications. The massive increase in microprocessor capacity and throughput is fundamentally changing the nature of the telecommunications business; the focus is now on software design and protocol development. The demand this places on standards resources is clear. To position standards to assure effective implementation of company network modernization strategies will require a managed commitment to the standards planning and development process, by participating in those standards fora that will most benefit business goals, while making efficient use of usually scarce technical resources.

Standards are critical to sustaining a robust information industry and a nation's communications infrastructure. Companies that participant in the information industry usually do or will compete throughout the world. However, it is probably impossible for the United States information industry or some other nation's information industry to succeed in a global competitive market without a robust modern communications infrastructure. There is no doubt that evolving standards in both domestic and international fora will determine to a great extent the communications infrastructure. The effective way to ensure that communications standards will not result in an economic penalty is to influence standards development through an active participation plan in key technologies based on a business strategy related to specific business goals. The alternative is to react to the influence of others. Usually these others may be your competitors in the global (or local) market.

6.0 Acknowledgements

Mr. Woody Saleh, Staff Director at NYNEX, was a great help in sorting out the international view of standards. Mr. Saleh and Mr. Victor Acosta (also a Staff Director at NYNEX) offered suggestions concerning examples and patiently read and re-read the manuscript. I thank them both for their valuable help.

WIRELESS EVOLUTION
NEW CHOICES FOR ASIA PACIFIC

by

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When it comes to the evolution of personal communications, the wireless options associated with cellular and other transmission methods provide Asia Pacific with a unique advantage.

The rapid advances in mobile telecommunications technology taking place in other parts of the world are too often slowed, if not actually hampered, by the need to take existing infrastructures and regulatory requirements into account. Asia, on the other hand, has the advantage of being able to select the most appropriate communications technology and protocol from any source. (See Figure 1).

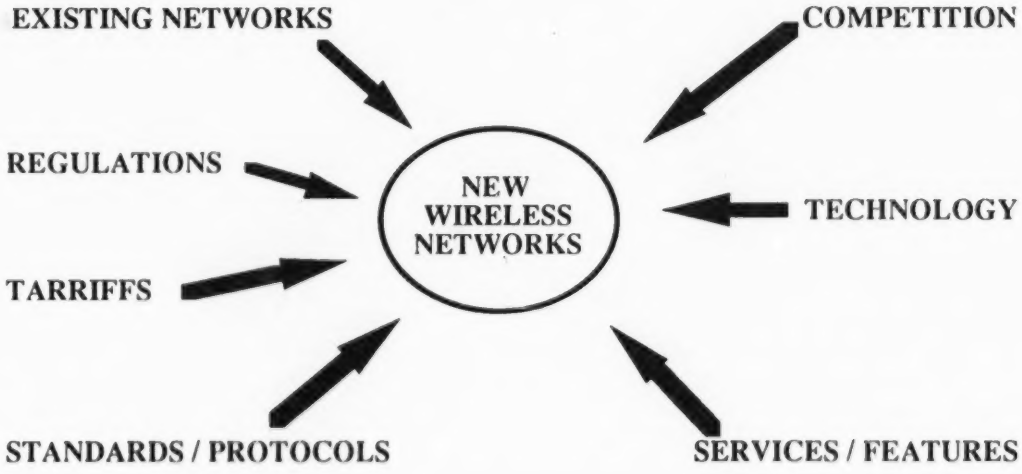

Figure 1. - Influencing Factors

Where necessary, this choice could mean a mixture of protocols and standards, subject to careful planning and a prudent assessment of the functionality to be deployed. As a pointer to the choices likely to face potential user countries, it is useful to examine how mobile communications is evolving in the US, Europe, and Japan.

In the US, despite the difficulties associated with analog cellular, the single AMPS (Advanced Mobile Phone System) analog standard has allowed cross-country uniformity

of systems which has brought associated cost benefits. Unfortunately, as subscriber demand has increased, so has pressure on the radio frequency spectrum.

This pressure is causing a split in the approach taken to solving a developing spectrum capacity problem. Different localized digital solutions are being proposed in an attempt to balance network capacity requirements with allocated spectrum. Several radio standards have emerged and the 1990's see several major divergent solutions competing for market share. (See Figure 2).

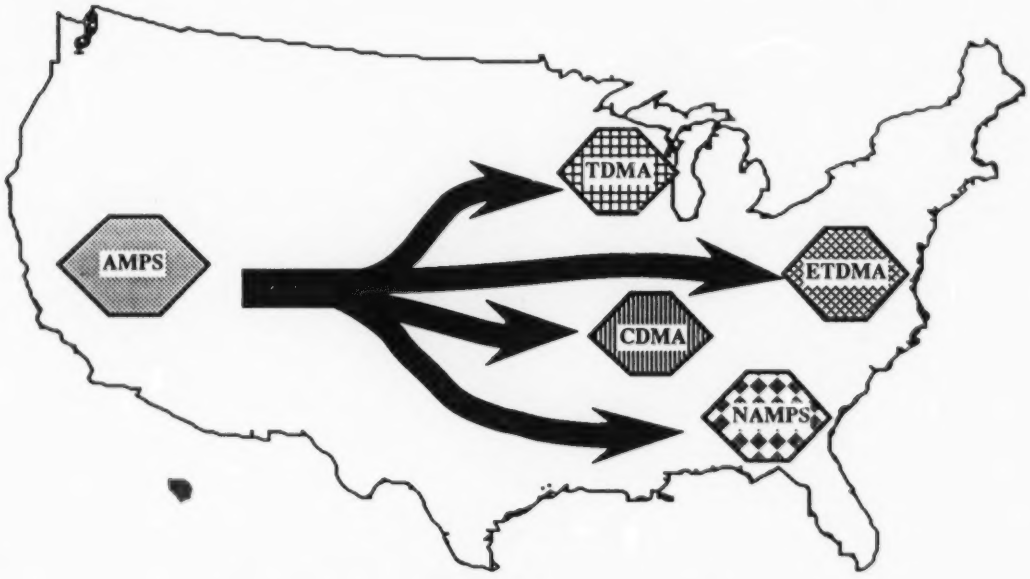

Figure 2. - US Standards/Protocols

Each is hailed as the solution to the efficient division of the radio frequency spectrum, each dominant in its own specific areas: NAMPS (Narrow band AMPS), CDMA (Code Division Multiple Access), TDMA (Time Division Multiple Access), ETDMA (Extended TDMA), etc. The result is a patchwork of mobile communications systems, each one incompatible, or compatible at only a basic level, with another.

Subscribers to these incompatible solutions are limited to their area of coverage despite the localized spectrum efficiency on offer. In the US, these digital technologies are, in effect, only access methods laid over the analog AMPS network. Roaming beyond the initial area requires commercial agreements between companies, but more important, handsets may be incompatible across subscriber regions which use alternate protocols. The economies of scale associated with a widespread, homogeneous infrastructure, and which bring lower cost handsets and services to market, may now be more difficult for operators to

achieve in the US. Several field trials are ongoing in the US at this time to prove out the merits of each technology.

In contrast, the evolution of cellular systems across Europe and Japan, although initially fragmented, has taken an interesting turn towards homogeneity that can yield useful lessons.

In Europe, the analog TACS (Total Access Cellular System), an outgrowth and improvement on AMPS, and NMT (Nordic Mobile Telephone System), was soon followed by an extended version, ETACS, joining Radiocom 2000 (France), CNetz (Germany), and versions of NMT in a complex pattern of incompatible systems across Europe. The now familiar patchwork effect has become apparent on an international scale. (See Figure 3).

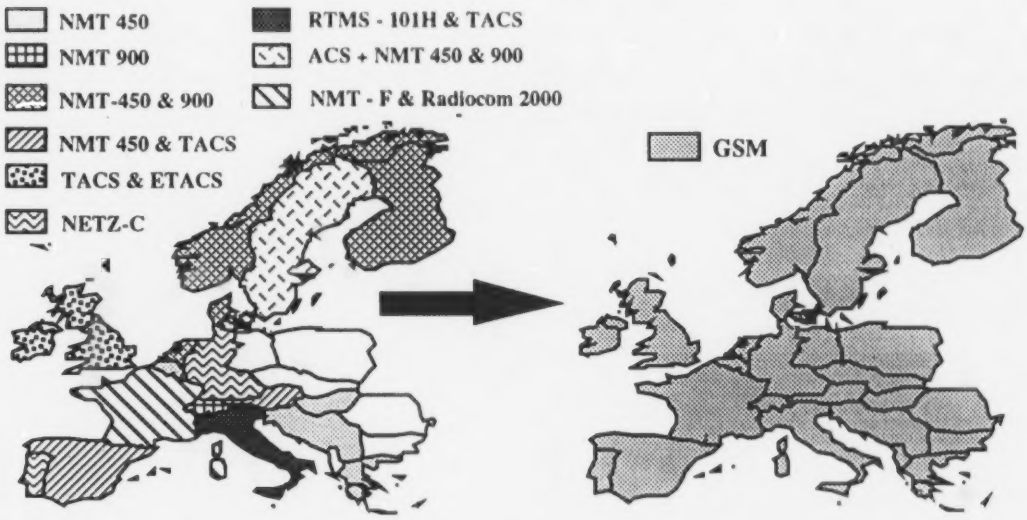

Figure 3. - European Standards/Protocols

Europe, however, has made moves to standardize on a new digital system to harmonize and provide mobility to the European Economic Community (EEC) as a whole. This system, which has evolved to be known as GSM (Global System for Mobility) has also realized the attention of many non-European countries, including several in the Pacific Basin.

In addition to full support from the 12 EEC members, GSM is being considered, or has also been chosen, as the future basis of digital cellular and Intelligent Network services by Australia, New Zealand, Singapore, Hong Kong and several countries in the Middle East, Eastern Europe and non-EEC countries.

Europe's approach to the capacity problem has been to allocate frequencies in the 900 MHz and

1800 MHz bands to accommodate the deployment of the new generation of GSM digital wireless systems.

Approximately 25 MHz of spectrum has been completely cleared across all of Europe at the 900 MHz band, and 75 MHz at the 1800 MHz band has also been cleared in several countries where capacity problems are expected (e.g. UK, Germany), and has been reserved in most other EEC countries. The 1800 MHz band, combined with the micro cell structure, will provide the extra capacity to deliver mobile cellular services to the population at large.

The global interest in GSM is partly due to the major effort being made in defining the infrastructure equipment and systems. Trial systems are already deployed, and commercial service is expected in several countries by mid-1992. Unlike cordless standards such as CT1(Cordless Telephone 1st Generation), CT2 (Cordless Telephone 2nd Generation), CT2+ (Cordless Telephone 2nd Generation Enhanced), and DECT (Digital European Cordless Telephone) and radio standards such as CDMA, TDMA, etc, GSM comprises a total open network specification, covering both radio and network interfaces and building blocks. (See Figure 4).

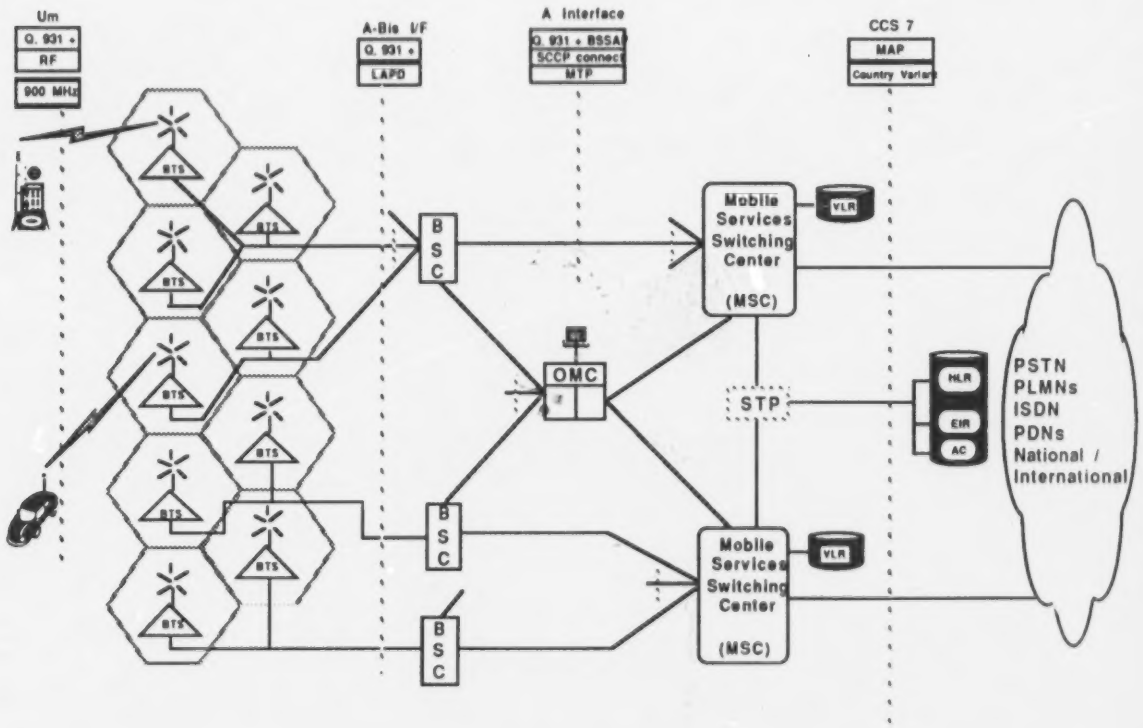

Figure 4. - GSM Model

The GSM standard is comprehensive, from the central billing and administration processing to handsets. It offers pan-European (and worldwide) roaming, high security, quality, and capacity. GSM offers the improved clarity associated with digital transmission, plus far greater reliability and consistency compared with analog cellular. Data services, being inherent, are faster and more reliable, obviating the need for modems.

The mobile network, with the GSM standard at its heart, can be a natural architectural and services extension of the fixed Intelligent Network, combining the traffic load of fixed and mobile subscribers on the same Intelligent Switch. It is both ISDN (Integrated Services Digital Network) compatible and AIN (Advanced Intelligent Network) friendly. A true "Intelligent" PCN (Personal Communications Network) could therefore evolve either from a mobile or a fixed network operation. (See Figure 5).

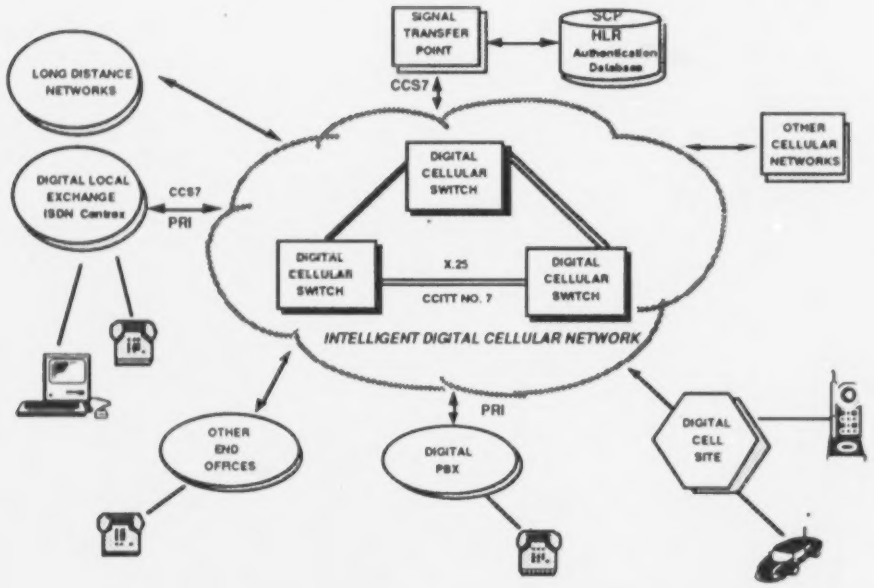

Figure 5. - Mobile Intelligent Network

In Japan, as in Europe, the evolution is also to a single digital standard, JDC (Japan Digital Cellular). (See Figure 6). It combines most network and functional characteristics of GSM (See Figure 4 - GSM Model), including ISDN/AIN capabilities and network architecture, with US-TDMA air interface type of protocols.

Other mobile techniques used in several markets, while appropriate in the absence of anything better, have similar limiting factors for a user base with growing expectations. Private Mobile Radio, for instance, provides effective coverage, but over a limited area. It is a closed system, with limited

capacity and lacks the signalling sophistication to interface to public or private voice/data systems.

The new wireless ISDN/AIN functionality and interface protocols will allow the deployment of enhanced revenue producing wireless features and services in the 1990's.

For their part, the 1980's will be remembered as the decade in which mobile communications flourished primarily through the introduction of cellular communications. The main emphasis of existing services deployment has been to provide extended coverage and network capacity. The 1990's will be characterized by quality enhancement and the availability of wireless communications features/services to the population at large.

Figure 6. - Japan Standards/Protocols

To date, users have for the most part been business and "status" subscribers. They have accepted high operating costs and inconsistent quality for the ability to make and receive calls away from the desktop or payphone. Network rollout timescales differ from country to country, as do expectations of the level of available services, but the growth of mobile communications continues unabated and at an unprecedented level.

Infrastructure and technological improvements in a free regulatory environment are only part of the solution; users must be given the right combination of services in a simple, controllable form to meet their individual needs. Services analogous to the PSTN (Public

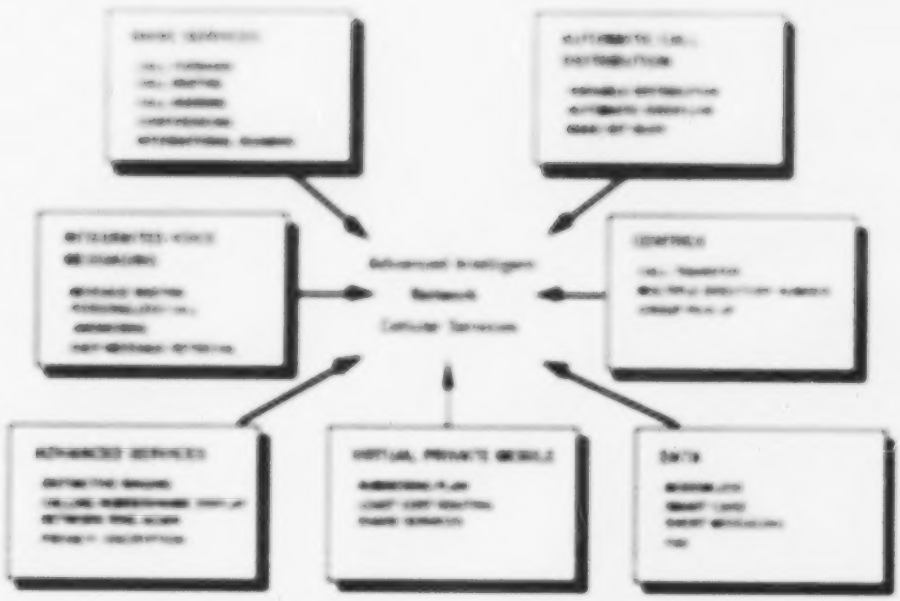

Figure 7. - Advanced Intelligent Network Cellular Services

Tariffs for local calls versus those for long-distance dialing are set to become a serious differentiator between service providers. The mobile network architecture should enable business services associated with centralized PBX's, such as call screening, call barring and least-cost routing, to be offered as part of the mobile package, with the same reliability as its fixed counterpart.

As a result, mobile services would then prove to be attractive to large corporate users, but in comparison with the conventional telephony, they will also be cost-effective for smaller organizations and, eventually, one-person businesses on the strength of extended functionality and mobility.

The attraction for countries already committed to ISDN based protocols, like GSM, is the ability to offer a mass-market service, rich in functionality, but recognizing that cost-effectiveness and control is critical. Corporate communications managers will only be interested in offering GSM handsets en-masse if the mobile network costs can be monitored and controlled to the same level as their fixed network. (See Figure 7)

Network operators can extend the control mechanisms inherent within the GSM specification to offer competitive accounting and billing services, such as selective barring, as well as value-added services. For their part, network providers have the challenge of delivering robust, high-capacity digital networks, including the AIN interfaces, across Europe and elsewhere.

Today, several digital technologies are being deployed throughout the world, catering to specific wireless applications, including cordless standards (CT2, DECT, etc.) and the new digital cellular standards including JDC, TDMA, CDMA and GSM, depending on the specific needs of each market.

Unlike the others, which are primarily air interface specifications, GSM and JDC represent a total network architecture consistent with AIN and ISDN, and therefore potentially compatible with the Fixed Network from a services ubiquity standpoint.

Learning from the pioneering work in the US, Europe and Japan, Asia Pacific countries can select viable and flexible architectures, able to deliver the right capacity and subscriber feature set to meet local and international user demand in an increasingly competitive world market. (See Table 1).

	AMPS	NAMPS	TACS	TDMA	CDMA	GSM/ PCN	JDC	CT2
Multi Market Acceptance	High	Low	Med	?	?	High	Low	Med
Enhanced Services (ISDN)	Low	Low	Low	Med	Med	High	High	Low
Quality	Med	Low	Med	High	High	High	High	High
Full Area Coverage	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No

Table 1. - Systems Characteristics

Exactly how the rollout of communications services, both fixed and mobile, corporate and personal, will occur is still uncertain. How well and how fast subscribers will embrace the new, enhanced

services and their global capability has yet to be tested. Which standards will prevail is also unclear, but will no doubt depend on regional initiatives and on the market drivers in individual countries.

The explosive growth of the 1980's showed that in spite of capacity problems, question marks over quality, limited services, high costs and the variety of standards, mobile communications is already destined to capture a very large number of users. It alone provides the freedom, flexibility and security in communications sought by the potentially huge mass subscriber population. What remains to be seen is the relative success of the various standards, and how ubiquitously these Mobility based networks will operate with existing and developing public and private fixed networks.

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ASEAN AND WORLD TELECOMMUNICATION DEVELOPMENT

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ABSTRACT

The world experienced global movement of capital, technology, goods and services, and people. This movements stressed the needs of three basic infrastructures, transportation, energy and telecommunication. The world competition will be on the area of trades, tourism, and with more concern on environment. This signifies the role of telecommunication as key infrastructure to achieve country and company competitive advantages.

ASEAN as a form of cooperation has put telecommunication as the area where strategic cooperation and alliance is the most important to balance the difference economic development achievement in its member countries.

In this relation, the ASEAN governments welcome the participation of foreign and private entities to invest in each ASEAN countries. The governments aware that they need to provide better climate for investments, trades and tourism. It is the reasons that economy deregulation and other policies to support the new and attractive climate were introduced.

1. INTRODUCTION

The evolving Pacific Rim economy is one in which economic and social relations among its members are rapidly intensifying. This intensification of relations is occurring as a result of greater flows of capital, technology, goods, services, and people between the west and east coasts and the northern and southern countries of the Asia-Pacific region. The capital movements include loans and aid, as well as portfolio and direct investments. The people movements include salesmen, workers, tourists, managers, students and immigrants. All of these flows increase the interpersonal contact between the Pacific Rim nations in a variety of overlapping roles as competitors, customers, suppliers, partners, classmates, and neighbors. The increasing interpersonal relation between and inside nations requires the existence of telecommunication facilities in the Pacific Rim region.

As we enter the twenty-first century the world situation is changing quite rapidly. The world economy has entered the globalization era. A number of trends that gathered strength in the late 1980s will shape the international economic environment of the 1990s. Seven of these, which will shape the patterns of relationships in the Asia-Pacific region can be formulated as follows:

a. the evolution of U.S.-Soviet relations from conflict to cooperation,

b. the collapse of communism in the Soviet Union and eastern Europe,

c. the reversal of U.S.' locomotive role in world economy,

d. the ascendancy of Japan as the world's banker,

e. the economic integration of western Europe,

f. the economic integration of north America, and

g. the emergence of China as world potential market

All of these ongoing changes are likely to combine to strengthen economic integration in the Asia-Pacific region.

The development of economic in the Asia-Pacific region requires the availability of three infrastructures, transportation, energy and telecommunication. These infrastructures are required to support the development in the Asia-Pacific nations. The availability of the three infra structure will secure any capital investment inflow to the developing Asia-Pacific nations. The needs of telecommunication infrastructure to guarantee the success of any capital investment is very obvious. The relocation of developed countries industrial estates to the developing countries will require a high quality and reliable telecommunication for control and transfer of information between the new industrial location and the head office. The unavailability of such facilities will certainly disturb the fast inflow of the capital investment to the developing countries in the Asia-Pacific region.

Compare to other region in the world, The Asia-Pacific region is the fastest growing economic region. It currently produces nearly half of the world's GNP and has more than one third of world trade. With a population of nearly two billion and economy growth rate of 5% per year for the last ten years, the Asia-Pacific region certainly has the potential to become an attractive market for consumer products and industrial estate in the next century. And as what other parts of the world experienced, Asia-Pacific is also experiencing the world competition on trade and tourism coupled with a high concern on environment. In this competitive era, telecommunication networks assume strategic dimensions for companies and countries who want to stay competitive in the 1990s. Many countries and companies have realized that to stay competi-

tive, they need information. To them information is the key to success. And there will be no information if there is no telecommunication networks. That statement is just to express the paramount need of telecommunication infrastructure in the new and modern business world. As Jan Bartkowiak of Interprego said that without telecommunication there will be no information, and without information you can compete. To the business environment telecommunication network is like the blood circulation in the body. Even the World Bank has stated that the world economy is increasingly becoming one base on the free and continuous flow of information.

2. INDONESIA'S ECONOMIC GROWTH

The enormous economic growth rate in the Asia-Pacific region also experienced by Indonesia. Futurists forecasted that the Indonesia's economic will grow high and steady. Contribution to country's economic growth is expected to come through the growth in non-oil export, foreign investment, tourism, and other domestic industries. Indonesia also need the three basic infrastructures to provide the favorable climate for foreign capital investment. The Indonesian government has stated that one of the essential ingredient needed to support the development of national economic activities is telecommunication. Good and reliable telecommunication facilities is very important in enhancing the international and national trade activities, supporting banking activities, increasing tourists inflow, new investments, and industry expansion.

The Indonesian economy in 1990 grew at a relatively rapid rate of 7.4%, down slightly from the 7.5% rate posted in 1989. Though the growth rate of the agricultural and mining sectors were below previous levels, the gross domestic product was still high due to the 12.3% growth rate posted by the manufacturing and construction sectors. From the National Investment Coordination Board's data, private sector investment on the manufacturing areas have shown a high and rapid growth. In 1990 itself, the manufacturing sector accounted for nearly 25% of the gross domestic product and was the source of 30.8 % of its increase. Indonesian gross domestic product has risen steadily from 85 trillion rupiah in 1985 to estimated 122.7 trillion rupiah in 1991 (center for policy studies' sources).

The Indonesian gross domestic product growth rate steadily increasing every year, from 5.5%, 5.9%, 4.9%, 5.8%, 7.5%, 7.4% and 6.3% for 1985, 1986, 1987, 1988, 1989, 1990 and 1991 respectively. Form the collected data, the Indonesian economy had begun to show some slow down starting from mid-1990 due to high inflation rate, the slow growth of export resulting from the international recession situation, tight monetary policy adopted by the Government to encounter the national high inflation rate and consumerism in Indonesian people daily life, and limited economy infrastructure facilities.

The sectoral composition of the Indonesian economy is shifting toward a balance between the primary sectors (agricultural and mining) and secondary sectors (industry and construction). For the first time in 1990, the share of industry and construction sectors to national the gross domestic product has surpassed the agricultural and mining sectors. The country also experienced an increase in the volume of imports of capital good and raw materials and falling prices for its primary commodities in the international markets.

Government investment is still the largest contributor to the growth of the national gross domestic product. With the constraint experienced by the Government to mobilized national funds, the Indonesian government is currently looking to find new sources for its national development programs. This policy stressed on mobilization of private and foreign investment programs by way of improving the investment climate in Indonesia. Improvement of the investment climate in Indonesia is done by way of national economic deregulation, loosening the tight investment procedures, and the most important action is to provide better national infrastructure in transportation, energy and telecommunication.

It is also important to note that in Indonesia presently experience a structural transformation process on its industrial system, as well as the change of social life value as a result of industrial revolution. The structural transformation process characterized by the direct link age of services requires by the industrialization process, such as transportation, energy and telecommunication infrastructures.

TADLE 1

ASEAN MEMBER COUNTRIES

	POPULATION	GNP/CAP	GDP GROWTH	L.U./ 100 POP.
BRUNEI	0.2	17,000	4.5	16
INDONESIA	184.3	520	7.0	.52
MALAYSIA	18.0	2,305	10.0	4
PHILIPPINES	6.9	727	3.0	1.5
SINGAPORE	2.7	12,716	8.3	4.3
THAILAND	56.2	1,416	10.0	1.9
JAPAN	124.2	23,570	0.4	55
U.K.	57.4	14,675	0.3	52
U.S.A.	252.3	21,860	0.8	76.9
CHINA	1,143.3	325	1.3	0.75

(ASIA WEEK APR.91)

From table 1 above, it shows that among the six ASEAN Countries, Indonesia is the most populous country with the lowest GDP per capita and the lowest number of line units per one hundred population. Therefore it is understandable why the Indonesian government is very aggressive in constructing telecommunication facilities in Indonesia.

Due to limited funds available, the government now is stressing on mobilization of private and foreign investment programs by way of the improving the investment climate in Indonesia. Some deregulations to promote private and foreign investment have been implemented. The government loosen the investment procedures but, that was not enough without improvement in the basic infrastructures such as transportations, energy and telecommunications. The government put these three in its priority list and opened up private participation whenever necessary and applicable such as the built, operate, and transfer (BOT) scheme in power plants, telecommunication, as well as in sea-port development.

In telecommunications, Indonesia has been left behind compared to other ASEAN countries. The telephone density in Indonesia is only 0.52 line units per 100 population (1990), while Singapore has reached 43, Malaysia 9, Brunei 16, Thailand 1.9, and the Philippines 1.5. We have to break and eliminate this bottle-neck caused by the telecommunication infrastructure. Some measures have been taken to speed up the progress of expanding the national telephone capacity in terms of the number of line units.

3. INDONESIA TELECOMMUNICATION SITUATION

Telecommunication facilities in Indonesia is handled by the Government. In daily operational activities, the Government run telecommunication services through its companies. PT TELKOM is designated as the domestic telecommunication carrier, as well as the operator of the country domestic satellite system, PALAPA. PT INDOSAT is designated as the international telecommunication carrier for Indonesia. It owned various submarine cable systems and operates INTELSAT satellite system in Indonesia. Both companies is owned by the Government.

As mentioned above, capital investments in one country need good national transportation, energy and telecommunication infrastructures. The increasing capital investment in Indonesia requires improvements in the national infrastructures.

Telecommunication is one of the important national infrastructure. The existence of a good telecommunication system in one country will increase the country's comparative advantage in attracting capital investment. This situation is in-line with the industrial relocations to the developing country. Economic globalization also stresses the requirement of telecommunication facilities to smoothen the relationship between the manufacturing and the head offices. Therefore the Indonesian government adopted policies which are implemented through its national telecommunication companies, that can be summarized into providing the best services to the customers, while achieving the best result for the shareholders and establishing the best corporate image for the telecommunication entities.

By end of 1991, the number of the national telephone lines is about 1.4 million line units. Comparing the existing telephone lines with the present demand, approximately there is a shortage of 1 million line units. The present telephone density is 0.64 for 100 population or less than 1%. This put Indonesia at the lower group in the provision of telecommunication facilities. Among the ASEAN countries, Indonesia is the lowest country in the national telecommunication provision and quality of service as well. Government and its telecommunication entities still have a lot things to do to improve the telephone density, and its quality of service.

Since 1988, the telephone line units average growth rate stays at 27.6% per annum, but the demand for telephone lines increases much more rapidly. Therefore it is very difficult to meet the demand with the present telephone line units construction capacity. With hardwork, the country has successfully increased the annual telephone lines construction capacity to almost six times, giving a total of 240.000 line units per year. Gradually the country will put effort to increase its development capacity into an average of one million lines per year in the 1994-1999 era.

Telecommunication infrastructure improvement is done not only in terms of adding and distributing more telephone line units. To become attractive for foreign involvement, Indonesia should also considered improvement in the types of services. In the global competition era, we cannot wait for information. Plain Old Telephone Service (POTS) is not enough. Various new advanced services, especially for high speed data communication are becoming more in demand.

On the other hand the fund available is limited, but the new Indonesian Telecommunication Law No. 3/89 still restrict any means for privatization in basic telecommunication. This policy was taken due to a certain condition that the government has to protect the public interest, especially people in remote areas. The need for development in remote areas may not be justified from just the business returns point of view if it is taken by private organization (some subsidy will be required).

The effort to accelerate telephone lines construction is not only facing threat from the

shortage of funds, but it is also facing the shortage of manpower, not just for construction and project management, but also for operation and maintenance. The number of telephone lines increases from 1.4 millions in 1991 to approximately 7 millions by 1999, reflecting a five times multiplication on the numbers of lines. This will also be reflected in the approximately same number of multiplication in the manpower required for the operation and maintenance. The Indonesian government is very well aware and concerned with this limited funds and manpower availability.

Other problem that the country faced in constructing the telecommunication infrastructure is the distribution of telecommunication facilities in Indonesia. This distribution of telecommunication facilities has a tight relationship with the economic activities in the country. Presently the concentration of economic activities in Indonesia is in the Western part of the country. This resulted in the telecommunication production in Western part of Indonesia being much more promising compared to telecommunication production in Eastern part of Indonesia. Furthermore this situation brought a dilemma to the telecommunication entities. As profit-oriented companies they have to maximize any opportunities to make profits, but as government-owned companies they have to support the government's programs to improve the quality of life of the Indonesian people through the development of telecommunication infrastructure in Indonesia. This second mission of the telecommunication company in Indonesia in reality will decrease the possibility to collect community funds needed for the construction of telephone infrastructure in Indonesia. While if the government decides not to construct the telecommunication facilities in the eastern part of Indonesia, it will slow down the national economic development in the eastern part of Indonesia, which at the end will have an impact to the overall economic development in Indonesia.

With this condition, environment and requirement specific to Indonesia, we then question the need for Indonesia to follow the world trend in deregulation and liberalization of telecommunication services. But we can understand the different objectives and approaches taken by other countries who have implemented their de-regulation, liberalization, or privatization. Indonesia is in full support to the policies that have been taken in other countries.

Indonesia took a different approach in deregulation through the new Telecommunication Law No. 3/89. In this law, all basic services should be handled by state owned operators, while non-basic services can be operated by anybody with government approvals and controls. Government encourages private participation in developing the non-basic services. While in the basic services the private sectors can participate with the cooperation and on behalf of state owned operators. The latter became important issues when the government introduces private participation in developing and operating local telephone exchanges through revenue sharing scheme (BOT). With this policy the government is hoping to be able to construct one million additional new line units every year for the next five years plan, which will bring Indonesia to the level of telephone density of 2.7 line units per 100 population.

4. INDOSAT'S CONTRIBUTION TOWARD THE INDONESIAN TELECOMMUNICATION INFRASTRUCTURE DEVELOPMENT

As the trend of economic globalization grows, telecommunication becomes a vital factor in creating the comparative advantage of any company in the competitive environment. Countries and individuals need to exchange information, in the form of texts, voices, or pictures. These information will be used for decision makings, negotiations, or promotional purposes. The national economic activities requires the support of telecommunication services. It is interesting to note that as the international telephone traffic growth, it grows in the same direction as the gross domestic product, import-export activities, foreign investments, and tourism activities.

For its customers, PT INDOSAT always try to improve its services. As the demand for the types of international services become more complex, PT INDOSAT has an obligation to provide the necessary services required by its customers. Following this policy, PT INDOSAT introduces new services to cater the need of a more modernized and global customers, with the understanding that this new services are required not only to maintain its customers and provide a good and reliable services, but also to eliminate the possibility of customers to turn off and find a more desirable service substitution. Some of the new services are Intelsat Business Services, International Direct Dialing, Home Country Direct, Electronic Mail Services, Voice Mail Box, and Store and Forward Fax. In general what PT INDOSAT has done is keeping up with the technology development through the introduction of new services, new technology implementation, promotion of information technology, and improvement and development of the international telecommunication facilities, such as switching, satellite and fiber optic submarine cable.

The need of better telecommunication infrastructure in Indonesia forced the government to utilize all of its owned resources. Mobilization of funds, manpower and other things on a nationwide scale is carried out by the government. The responsibility of improving the development of national telecommunication infrastructure is not the sole responsibility of PT TELKOM as the national domestic telecommunication carrier, but it also the responsibility of the Indonesian telecommunication community.

PT INDOSAT being one of the important player in the Indonesian telecommunication community has a morale obligation to support the government programs in improving the national telecommunication infrastructure. To implement this morale obligation, PT INDOSAT launched the national telephone development program called JOINT COOPERATION PROJECTS for national telecommunication facilities. In this scheme, PT INDOSAT as the country international telecommunication carrier, functions as the assistance to PT TELKOM's projects of national telecommunication infrastructure development. PT INDOSAT provides the funds, manpower for project managements, and efficient methods of procurements. At the completion of the project, the operation and maintenance, as well as the asset, will be transferred to PT TELKOM through the government.

5. INDOSAT IN THE INTERNATIONAL TELECOMMUNICATION COOPERATION

PT INDOSAT also contributes to the international telecommunication activities. Its contribution in the international fora has been proved. But more importantly, with the involvement of PT INDOSAT in the international telecommunication organization activities and international fora, it improved the understanding of an up-to-date world telecommunication development. This knowledge will be brought to the national fora, where PT INDOSAT acted as one source of input to the government regulatory body. This up-to-date input of the world telecommunication situation will make the government's function as a regulatory body could be exercised effectively. Therefore PT INDOSAT hopes that the regulation applied in Indonesia could follow the fast technology and demand development.

PT INDOSAT's participation in the world telecommunication development is also recognized. The involvement of PT INDOSAT in the world submarine cable networks as initial parties or just IRU user proved the commitment to support the international telecommunication development. PT INDOSAT also had several bilateral programs with foreign telecommunication administrations. Exchange of expertise program is also conducted by PT INDOSAT by means of providing satellite technology courses under the arrangements of Asia-Pacific Telecommunity.

6. THE ROLE OF ASEAN COOPERATION IN THE DEVELOPMENT OF REGIONAL TELECOMMUNICATION NETWORK

The ASEAN cooperation was formed by the five ASEAN Countries' Head of States in August 1968. The objectives of this cooperation is to promote and synchronize the South East Asia regional economic development among its member countries. As time moves on, the ASEAN cooperation is expanded, not only in the number of countries joining this cooperation, but also the area of cooperation is expanded as well. Today, the attention is not limited to the economic activities cooperation but also to area that supports economic developments. Telecommunication is also included and viewed as the important infrastructure in the economic development. It is the agreement among ASEAN member countries, that they need to coordinate their countries telecommunication operation and development to obtain the highest synergy to support the region economic development. This idea is behind the formation of a Sub-committee on Post and Telecommunication. The Sub-committee on Post and Telecommunication function to coordinate the ASEAN member countries' telecommunication operation and development. This Sub-committee meets once a year and reports the coordination results to the Minister in-charge of telecommunication and Minister of Foreign affairs.

Activities that has been done by the ASEAN countries in the light of cooperation can be listed out as follows:

a. Exchanges of expertise,

b. Sharing of resources, such as the use of ASEAN cable depot in Singapore,

c. Joint developments, such as the construction of the ASEAN optical submarine cable network,

d. Tariff policies, such as what Singapore and Brunei Darussalam done,

e. Common interest in the international fora, such as setting up a common position in the ITU meetings for the region's benefit, and

f. Technical standardization, such as the agreement on the type of cellular mobile communication system to enable automatic roaming for ASEAN countries.

Each year the development on the policies and the telecommunication facilities is reported by each country to the Sub-committee for coordination and guidance of future actions. All is done under the ASEAN spirit of cooperation.

The general objectives of these arrangements are to support each country's individual interests and goals on the development of the telecommunication facilities, as well as to secure the region from being used by other counties that have technological advantages compared to the regional countries. The cooperation is also intended to secure the member countries' competitive advantages in the world markets. The country's competitive advantage is very important to ensure the fast and continuous development of each country, by means of offering the best environment for investments, trades, and tourism. With this kind of alliance, the ASEAN member countries would also able to contribute lots to the development of Asia-Pacific region.

The difficulty in developing the economy may not be the same in each country. The opportunity for one country to overcome its development problem may also be different from country to country. In the globalization era, one country may come up as the winner in this competition, but it may not worth if other country can not survive.

Since telecommunication is a part of one country's infrastructure that plays an important role in the development of that country, we cannot separate telecommunication from other sectors. Cooperation among nations in developing their telecommunication infrastructures is a must in the spirit of getting the mutual benefit that can be realised as improvement in the country's development in all aspects. Therefore we should promote the cooperation not only among governments, operators and suppliers who are involved in the telecommunication activities. But the cooperation should also extend to others from other sectors as the users to identify how the telecommunication should be developed for the benefit of the country as well as the world.

As a member of ASEAN Group, we would like to see that we can start to promote the cooperation within the ASEAN member countries. What has been experienced by Indonesian telecommunication community may be learned by other members. The success of one country is also interesting to be studied by other members.

As a regional group, ASEAN can not isolate itself from the rest of the world especially the Asia-Pacific region. Therefore, the cooperation should then be extended in the international forum to face the future challenges :

- Based on recent developments in the world, we can expect that the competiton will become tougher among the telecomunication operators, among the telecommunication users, as well as among the nations.

- Technology will drive the development; who has the technology may control the world.

- Power, whatever the forms : financial, armed forces, or others, can be exploited negatively by a person, a group of people, a nation, or a group of nations.

Many international telecommunication forums or organizations have been established such as ITU, APT, PTC, PPM, APEC, and others. We should utilize these organizations more effectively and develop communication among them to avoid duplication and wasting of resources. The challenges are not only for developing countries, or developed countries, but for all of us.

7. CONCLUSION

Telecommunication is one of the important infrastructure which can influence the economic development of the country. Each country has a different difficulties constraint and ability to overcome this infrastructure problem. But what has been experienced by one country can and should be shared by the others.

As a world community, we cannot leave behind some countries under-developed. There is a strong relationship between telecommunication sector and other sectors. The telecommunication development should involve other sectors to get the optimum benefit for mankind.

The key is cooperation. It should be promoted and strengthened among nations. Let us work hand by hand in facing the future challenges. Strategic cooperation and alliance between nations or entities will improve the nations or entities' competitive advantages.

GLOBAL DREAMS AND REGIONAL REALITIES

Mankind has always had universal dreams of unity, brotherhood, perfection behind, or beyond the more pedantic realities of village, tribe, nation, religion, or culture. As we race towards the 21st Century, talk increases of a new world order, a New Age, a global ethic and so forth, and this is the language of politicians and the ordinary man not just preachers, prophets or philosophers.

The telecommunication community shares a common dream - Arthur C Clarke's "global village" with networks enabling anyone to talk to anyone else anywhere, anytime. Computer and communication hardware and software technologies are advancing rapidly to make this dream come true. The roll out of SDH transmission, ATM switching, intelligent networking, millimetric and satellite based cellular is a universal phenomenon matching the globalised needs of commerce, finance, and industry. Advances in the production of memory devices and translation machines are accelerating the day when remote access to the accumulated wisdom of mankind will become commonplace, transforming the long-established habits of obtaining and providing health care, education, and work.

At the same time, transport technologies can be expected to make similar radical breakthroughs. Cutbacks in military expenditure can release resources for conversion programmes not only in Russia but also in Europe, Japan, and the United States. Supersonic passenger planes cutting travel time from Washington to Tokyo to 2 hours, and high speed rail linking the major cities of Europe in 1-2 hour travel times will help globalize the mobility of people to US levels which are the highest in the world. Microplanes may also replace the motorbike and extend the distances coverable by single person transport modules.

The portable phone will match the ever more mobile person. The hard logic of the telecommunication and transportation revolutions is to extend each individual's access to and accessibility from all parts of the physical, intellectual and cultural worlds. At home each

person will have access to information, entertainment, and real live events wherever generated; the rest of the world will be as accessible to the person on the move as today's offices or factories to the average commuter.

The Juggernaut of Technology is so strong and all pervasive that there is no longer any question of whether the telecommunication and transportation communities dreams will come true; it is only a matter of how and when.

The how and when will be determined by the realities that shape the wealth of nations, international and national resource allocation, regulation, decision-making. It is in this crucial area that regional factors cut across global desiderata.

The meltdown of the Iron Curtain has unleashed seismic changes in the geopolitical landscape. The EC of 12 looks set to become an EC of 20, 25 or 30 as EFTA, Central Europe, and the Soviet Republics redefine the shape of the European Community from a Western European entity into one that stretches from the Atlantic to the Sea of Japan and from the Arctic to North Africa. Few in the EC and certainly hardly any in the PTTs of the EC recognise the significance of these changes now in train.

Without in any way losing its central global role, the USA seems set in giving the Americas a new cohesion as a trading bloc if the NAFTA concept moves south beyond Mexico.

At the other end of the Pacific, a new trading community seems to be clustering around Japan as the Pacific Rim countries of Asia knit ever closer together in the wake of the explosive economic growth they are undergoing.

A fourth distinctive group may emerge if the Middle East Peace Process reaches a positive outcome liberating the countries of Islam from their obsession with Israel - namely the Islamic Community of

nations stretching from he Atlantic to the Pacific and from South Russia to South of the Sahara.

These regional fallouts in the wake of the end of the Cold War are macrocosms of the sort of divisions which are commonplace in our great metropolitan cities of today - New York, London, Tokyo, Hong Kong all contain distinct communities with differing interests and life styles while enjoying the same forms of telecommunications and transportation.

Telecommunications and transportation might be creating and serving a borderless world but they cannot remove the inner borders set by different communities of interest for themselves. Quantitative tariff barriers can be reduced to zero but the qualitative so-called non-tariff barriers create new constraints and are more difficult to remove.

The drive towards the global village, the global network, the global market place is accompanied by the equal and opposite drive towards regional, local, and eventually individual customization.

This is not necessarily a contradiction and can be compared to the familiar telecommunication model of the private customer, the local telco, the long-line and international telco, the PSTN and private networks all interacting in a network of networks.

Regional free trade zones can contribute towards achieving the global objectives of GATT so long as they are outward looking and open to interaction with other Regional free trade zones. The protagonists of EC, NAFTA, and the as yet unformulated Asia Pacific Group, all state that they are open and outward-looking.

In the case of the two regions on each side of the Pacific, this claim seems to be justified. Indeed, while there is no Pacific Treaty or Charter and no formal Pacific Economic Community, the movement of people and ideas across the Pacific has been dramatic.

The economic, social, and political transformation of South-East and North-East Asia has been aided and abetted by the migration of Asians to North America and Australasia and the export of North American ideas and technology to Asia. California, the Pacific North West and British Columbia are great havens for the new Asia rising in America. Meanwhile in Japan, Korea, Hong Kong, Taiwan and the ASEAN countries, the best of North American business and technological experience is absorbed and applied in dynamic wealth creating ways.

The peoples of the Pacific Basin from Australasia in the South via ASEAN and the great coastal cities of China up to Sakhalin and Alaska in the North including Japan and Korea, and from Chile in the South of the Americas up to Alaska via Mexico, USA and Canada constitute around 1 billion in number with many languages, religions, and political systems. The movement of goods, people, services and finance between this region is already the most dynamic and extensive in the world, more or less ensuring that the 21st century will be the Pacific century with the largest ocean in the world being transformed into an inland lake.

This prospective Pacific economic miracle generating some 60% of world GDP is supported and reinforced by the roll out of a new telecommunications infrastructure.

Before moving to the FCC Al Sikes presided over the NTIA study which set the universalisation of Broadband ISDN services as the US national telecommunication goal by the year 2000. In Japan, NTT is dedicated to bringing fibre to every home by the year 2015. In both the USA and Japan telecommunication deregulation and network pluralism are driving the delivery of this new infrastructure. Across the Pacific it was also the FCC decision to introduce international facilities competition that gave a kick start to the new catscradle of submarine fibre optic cables crisscrossing the Pacific. It was only 5 years ago that the pioneering initiative of IDC, Cable and Wireless and Pacific Telecom in planning NPC, the first direct link between Japan and the United States, the two largest economies in the world, was dismissed by the great and the

good in the telecommunication community as a misguided aberration. Today, the competitive response of the traditional carrier community has been massive and continuous: instead of TPC 3 which was supposed to serve the Pacific requirements up to 1996, we now have NPC, TPC 4, TPC 5 and 6, PACRIM East and West, PAC, H-G-P,and there is now talk of APC 2.

The Pacific Ocean has no landlords. The Ocean floor is rent free and it is already cheaper to call San Fransisco from Tokyo than Hiroshima from Tokyo. The introduction of broadband electronic highways will accelerate the introduction of electronic markets for an array of goods and services, and electronic platforms for the handling of health, education, R&D and live events. With ATM switching and 10 gigabite transmissions systems, there is no economic or technological reason why NTT's famous local 10 yen zone should not encompass the whole Pacific basin. The boundaries between local, long-line, and international will collapse and carriers will have to learn to treat the whole region as a single market when constructing their networks and service offerings of the future.

The single Pacific market will emerge bottom up as part of a common sense technological and economic solution to the benefit of its 1 billion customers with telecommunication and transportation technologies as key catalysts.

The second super Region will be the EurAsian landmass. Here politicians and civil servants rather than technology are predominant. The ever expanding EC is essentially a top down phenomenon. While EurAsia's 800 million people have many languages and political systems, there is far greater cultural homogeneity in the Region from Dublin to Vladivostok than in the Pacific basin.

Because it is a landmass, there are many landlords and many boundaries to be crossed. Paradoxically, the vast oceanic divide and the cultural heterogeneity betwen the nations on both sides of the Pacific create an openness to technological and economic homogeneity, whereas in EurAsia the cultural homogeneity and physical proximity

have created barriers to crossborder technological and economic penetration and an instinctive protectionism in defence of national identities. The nations of EurAsia suffer from what the psychologists call "core complex" - an inability to strike the right balance between fission and fusion in relations with each other.

In telecommunication terms, the Eurasian landmass is a patchwork quilt of different networks. In an excellent editorial on 22 November 1991, the *Financial Times* made the following pertinent observations:

> "Efficient transcontinental telecommunications networks underpin the US economy. Europe, by contrast, makes do with a patchwork of domestic networks. However efficient these networks may be for local communications - and most are far below US standards - communicating from one end of the continent to the other is frustrated by high prices, poor quality and a web of monopolistic restrictions."
>
> "The heaviest burden Europeans bear as a result of the continent's fragmented networks is the price of long-distance calls. A three-minute call from Boston to Washington DC - a distance of about 650km - costs the user 69c at peak rates, says the consultants, Logica. But a call from Paris to Milan, about the same distance, costs FFr11.37 ($2.08), nearly three times as much. One from Milan to Brussels, again the same distance, is four times as much - L3,556 ($2.94). At off-peak times, the disparity is even greater."
>
> "Although crossing frontiers is particularly expensive, long-distance calls within one country are also costly by US standards. A call from Marseilles to Paris costs FFr6.51 ($1.19), while one form Naples to Milan is L2,113 ($1.75). US consumers can call from Miami to Anchorage - 10 times the distance - for only 91c."

At Maastricht, the EC politicians mapped out routes towards monetary and political union to build on the moves to achieve a single market by 1993. Nothing, however, was done to alter the structure of the EC telecommunications markets, where the PTT monopolies continue to dominate within the boundaries of national sovereignty. Post Maastricht, the lack of PanEuropean long line carriers is anachronistic. For a call from London to Paris or Paris to Bonn to be classed as international - that is crossing national frontiers - is absurd when these national frontiers are being abolished for purposes of the movement of goods, services, and people. As cross-frontier talk constitutes some 5-7% of PTT revenues, the establishment of PanEruopean and eventually PanEurasian carriers would not have a large impact on the revenues of the PTT monopolies. The US and Japanese experience demonstrates that competing long line carriers do not damage local monopolies. Indeed, the reverse is true. There are 20 times more telephone lines per head of population and each line is used 3 times more in USA than in Europe.

The European PTT counter-argument does, however, deserve a hearing. There is a strong feeling in Europe that transmission networks are a natural monopoly and there is a case for treating national telecommunication transmission networks like the electricity or railways grid and liberating access to this grid completely for all services from the bottom to top of the OSI ladder. The regulators in Sweden and Germany are reflecting on such matters and the Communication Unions in Britain have been toying with similar ideas. Network monism rather than network pluralism might, therefore, be the European road into the ATM/SDH era. The burden of universal service is the other justification used in support of the continuance of

special privileges in infrastructure operation and voice conveyance. Not ony does this ignore the UK, US and Japanese experience, but overlooks that after more than a century of keeping faith with the monopoly model, the vast majority of ITU member countries are nowhere within reach of achieving universal levels of penetration of the basic telephone instrument.

As the old Scottish ballad says - there is a high road and a low road to Loch Lomond. It will be interesting to see whether the network monists or the network pluralists wins the race to arrive in the Scotland of the Information Era!

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NOVEMBER 1991

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LOW EARTH ORBIT SATELLITE SYSTEMS

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INTRODUCTION

Reflecting current interest in low earth orbit satellite systems, in 1990 six companies sought authorization from the Federal Communications Commission (FCC) to use low earth orbiting satellites for a range of domestic and international telecommunications services including mobile voice, data, personal communications and position location. Further demonstrating the high level of interest in this new satellite communications technology, in June 1991 three additional companies submitted low earth orbit satellite proposals to the FCC.

This domestic activity parallels increased international interest in the commercial potential of low earth orbit satellites, and has brought to the forefront the domestic and

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defined as satellite systems in non-geostationary orbit.[3] Geostationary orbit lies approximately 22,300 miles above the earth in the plane of the earth's equator. Satellites in a geostationary orbit remain in a fixed position relative to the earth.[4] In contrast, LEO satellites are not geosynchronous and are placed into a "lower" orbit. For example, Motorola's Iridium system, discussed below, is to be located 413 miles above the earth; the orbits specified by other LEO applicants range from 5,600 miles to 550 miles above the earth. LEOS circle the globe, either pole to pole, around the equator, or anywhere in between. As a result, LEOS are inherently able to achieve nationwide or

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[3] Although there are different types of non-geostationary satellites (e.g., low earth orbit, elliptical orbit, circular polar orbit), this discussion uses the term LEO broadly to describe all non-geostationary satellites. Although the terms "small satellite" and "LEO" are often used interchangeably, it should be pointed out that the two may be but are not necessarily the same. LEOS are typically small satellites in that they weigh and cost less than the large geostationary satellites historically used. (Small satellites are generally defined as those weighing less than 1000 lbs. and costing less than $20 million dollars. See Stern, Lacohie & Zygmont, An Assessment of Potential Markets for Small Satellites, 5 (1989).) However, small satellites can be, and have been, proposed to be placed into geosynchronous orbit. See Application of Afrispace, Inc., FCC File No. CSS-90-017, filed July 23, 1990. Small satellites are particularly suited for low earth orbit because the higher power levels and other technical characteristics necessary for communication from geostationary orbit are not required. In addition, as the result of savings in construction and launch costs, small satellites offer promise for a variety of communications and other commercial uses.

[4] See 47 C.F.R. § 2.1(c) (1989).

policy. To the extent that geostationary satellites have been the dominant technology and formed the model for domestic and international regulation, LEOS raise novel regulatory and policy issues that must be considered and resolved if LEOS are to fulfill the public benefits envisioned. Indeed, whether the full potential of LEO satellite systems is realized in the future will be determined in large part by how these systems are treated from a spectrum allocation and regulatory standpoint.[8]

While some of the differences between geostationary and non-geostationary satellites are highlighted above, it bears emphasis that both types of satellite systems share many similarities from a communications standpoint and should be viewed as alternative means of providing vital communication services.[9] Although beyond the scope of this discussion, among the international regulatory issues potentially applicable to both LEOS and GEOS

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[8] The FCC also needs to carefully examine its satellite regulatory scheme to determine its impact on LEOS. For example, the FCC has interpreted the filing fee for space system applications (including the $70,000 launch application fee) to apply on a per satellite basis. In that LEO systems typically involve multiple numbers of satellites, a disproportionate fee may result. Based on a 77 satellite system, for example, Motorola could be required to pay over $5 million solely for its FCC launch application.

[9] The FCC has required LEO applicants to follow the same application procedures as other satellite applicants. Those procedures are set forth in Domestic Fixed Satellite Service, 93 F.C.C.2d 1260 (1983) at Appendix B.

that can potentially be provided by non-geosynchronous satellites.

a. Proposals Below 1 GHz.

Spectrum allocations for LEOS have been requested in the 137-138 MHz and 148-149.9 MHz bands.[13] A petition for rulemaking to establish a frequency allocation for a Non-Profit International Low-Earth Orbit Fixed Satellite Service in the 200-800 MHz bands has also been filed.[14] In addition, applications have been filed for licensing of LEO satellite systems in the 137-138 MHz and 148-149.9 MHz bands, and in the 200-800 MHz bands, respectively.

Orbital Communications Corporation (Orbcomm) proposes to operate a 20-satellite system of low earth orbiting satellites that would provide two-way data communications and position determination services primarily to mobile subscribers in the 50 states, Puerto Rico/Virgin Islands, U.S. Pacific Islands and the

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[13] See Petition for Rulemaking of Starsys, Inc., RM-7399; Petition for Rulemaking of Orbital Communications Corp., RM-7334, Public Notice Report No. 1814, released April 4, 1990.

[14] See Petition for Rulemaking of Volunteers for Technical Assistance, RM-7612. VITA has proposed two alternative frequency utilization plans.

MHz bands consisting of two low-orbit satellites.[18] The VITASAT system would use fixed or portable earth stations to provide educational, health, environmental and disaster relief communications services to developing countries.

From a procedural standpoint, the FCC has not yet indicated how it intends to process the pending applications of Orbcomm, Starsys, VITA and Leosat. A threshold issue is the availability of spectrum for the LEO systems, both domestically and internationally. The FCC has recommended to the U.S. Department of State, in connection with the WARC-92 proceedings, that spectrum in the 137-138/148-149.9 MHz bands be allocated internationally for LEOS on a primary basis.[19] This international recommendation suggests that the FCC is likely to take favorable action with respect to a domestic allocation in the same bands. Apart from the spectrum issue, the FCC needs to consider licensing and regulatory policies for the proposed services.

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[18] Application of VITA, FCC File No. CSS-91-007-(3), filed September 20, 1990. The VITA application was accepted for filing on April 11, 1991. See Public Notice, Report No. I-6563, released April 11, 1991.

[19] See An Inquiry Relating to Preparation for the International Telecommunication Union World Administrative Radio Conference for Dealing with Frequency Allocations in Certain Parts of the Spectrum, Report, Gen. Docket No. 89-554, FCC 91-188, released June 20, 1991 ("WARC Report") at 17. WARC-92, and its significance for LEO proposals, is discussed in greater detail below at pp. 11-14.

Unlike the companies interested in spectrum below 1 GHz, these five companies have proposed to use spectrum currently allocated to the Radiodetermination Satellite Service (i.e., 1610-1626.5 MHz and 2483.5-2500 MHz).

Ellipsat has proposed a two-phase satellite system, ultimately consisting of 24 elliptical orbit satellites, to provide RDSS and mobile voice (cellular) services to vehicles within the continental United States and domestic offshore points. Through the use of small satellites, Ellipsat projects that it will be able to augment existing cellular services at a cost comparable to terrestrial systems. Motorola's Iridium system will consist of 77 low earth orbit satellites in seven polar orbits providing worldwide digital mobile personal communications services using frequencies in the 1610-1625 MHz band. Motorola plans to work through international partners to offer its proposed services which include paging, messaging, voice, position location, facsimile and data services.

Loral proposes a 24-satellite system, called Globalstar, offering radiodetermination satellite, voice and data communications. Qualcomm, one of the principals of Loral, is currently a provider of radiodetermination satellite services using in-orbit domestic fixed satellites. TRW plans to construct the Odyssey radiodetermination and mobile communications satellite system, consisting of twelve satellites in "medium"

2. WARC-92.

In 1992, the International Telecommunications Union (ITU) will convene a World Administrative Radio Conference to discuss specific issues involving the international allocation of radio spectrum for mobile services. The WARC Agenda, adopted in June 1990, proposes, among other issues, to "consider possible allocations of up to 5 MHz of a frequency band below 1 GHz to low-orbit satellites on the basis of appropriate sharing criteria."[23] It is noteworthy that the proposed scope of WARC-92 did not initially encompass LEOS, but the proceedings were later expanded to include consideration of a generic LEO allocation.

As formulated by the WARC Agenda, the issues of spectrum allocation and sharing criteria for LEOS will need to be considered at the 1992 conference. International regulations do not presently define non-geostationary satellites or specifically address use of allocated frequencies by such satellites.[24] One issue that needs to be addressed at WARC, for example, is the applicability of the ITU advance publication, coordination and notification procedures to LEOS.

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[23] See Section 2.2.4(d), WARC-92 Agenda, 45th Session ITU Administrative Council, Document CA45/7042-E (June 20, 1990).

[24] The only apparent reference to non-geostationary space stations in the ITU Radio Regulations appears in Article 29, Section II, which sets forth standards for control of interference to geostationary satellite systems.

in response to comments raising the issue of LEOS above 1 GHz,[28] the FCC issued a Supplemental Notice of Inquiry in March 1991 to address LEOS and other issues.[29] In the Supplemental Notice, the FCC proposed to allocate additional spectrum above 1 GHz for LEO MSS use.[30]

In its final WARC Report, released June 20, 1991, the FCC recommended that the 1610-1626.5 MHz and the 2483.5-2500 MHz bands be allocated for mobile satellite use, for both geostationary and low earth orbiting systems, on a co-primary basis with RDSS.[31] It also proposed to allocate the 1850-1990 MHz band for mobile satellite use, either LEO or GEO, on a primary basis. The FCC indicated that it is prepared to work with other administrations at WARC-92 to develop the necessary procedures for coordination of LEO and GEO systems.[32]

WARC-92 will provide a critical first opportunity to consider the international spectrum allocation and regulatory

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[28] See, e.g., Reply Comments of Motorola in Gen. Docket No. 89-554, filed January 8, 1991; Reply Comments of Ellipsat Corporation, filed January 8, 1991.

[29] See Supplemental Notice of Inquiry, Gen. Dkt. No. 89-554, FCC 91-73, released March 20, 1991.

[30] Id. at paras. 19-23.

[31] WARC Report, supra at 15, 19. The FCC allocated the 1613.8-1626.5 MHz band on a secondary basis in the space-to-earth direction.

[32] Id. at 21-22.

Voice Enhanced Applications Enabled Through the Use of an Application Program Interface

Daniel E. Stone

IBM Corporation

Abstract

Managing the interaction of switches and computers to enhance existing business applications, which rely on the use of a telephone, represents both a tremendous business opportunity and a formidable technical challenge. This paper describes how an architected telephony services application program interface enables the enhancement of these business applications, overcomes the technical challenge, and provides multiple benefits to both the business employing the technology and the end user, their customer.

Introduction

Over the past decade many changes have occurred in the telecommunications world; new organizations, new businesses, new technologies, new services to users. In spite of all this change, basic voice service is still key to modern business communications. The transport facilities for delivering that voice service have been on a constantly increasing slope of value, quality, and reliability. There is now a need to ensure that the handling of the call, both inbound and outbound, is done in a way that provides for the same degree of quality and efficiency as the transport.

Any successful business that depends on large volumes of business transactions conducted over the telephone will have already taken maximum advantage of data processing to improve the handling of these transactions. On line customer record systems, exhaustive account management and order tracking, efficient order processing and inventory management have all been implemented to maximize productivity and customer service and minimize costs. This effort will continue unabated but there are now available new technologies and products to realize even greater efficiencies in the processing of a voice based business transaction.

Customer Environment

Many businesses that handle large volumes of voice based business transactions do so through a Call Center. A Call Center may support inbound call services such as reservations, order processing, account enquiries, credit verification, and help desk. Outbound services such as lead generation, overdue billing enquiries, appointment confirmations, and many others may also be supported. In either case a Call Center can be characterized as consisting of a set of agents who are 1) answering an incoming or placing an outgoing call, 2) prompting the client for information, and 3) providing some form of service. The agents will usually have a computer terminal as a basic part of their work station to assist them in the processing of calls.

Normally, the call handling and data processing activities are coordinated only through the actions of the agents themselves. No direct linkage exists between the data processing systems and the voice processing (switch or automatic call distributor) systems to assist the agent. This means that the agent has to spend time accessing data records related to the call once the client is identified and the reason for the call established. If the agent has to transfer the call to another agent this will most likely result in the second agent having to start over from the beginning to access data records related to the call.

Voice Transaction Automation

Switch Functionality

In an effort to automate the processing of telephone based business transactions many technological improvements have been introduced into the systems involved. Modern Private Business Exchanges (PBX) and Central Office based Centrex services offer many features which improve the handling of incoming calls. These features include such capabilities as call forwarding, conference calls, call logging, call holding, direct inward dialing, and on-hook dialing (hands free operation).

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- Alter the set of answering prompts based on time, date, or other factors
- Request information from the caller
- Interpret DTMF responses or perform speech recognition
- Access data in attached hosts depending on responses provided by the caller
- Accept input data from the caller and send to attached hosts
- Identify the caller via requested identification information
- Transfer the call to a live agent
- Terminate the call

Based on the functions identified above, the typical VRU is capable of either handling a call completely independent of human interaction or serving as a pre-processor for complex transactions, only handing off the call once all the preliminary data has been gathered and the caller identified to the point of ensuring that the call will be processed by the appropriate person. VRU's can also provide coverage of critical telephone numbers during periods of peak traffic or during off business hours.

Voice/Data Integration Directions

Standards Activities

Recognizing the need to merge the automation capabilities inherent in data processing facilities with the automation capabilities available through modern digital, stored program controlled switches manufacturers of both sets of equipment have cooperated with national and international organizations to develop draft standards defining switch to computer application interfaces.

The European Computer Manufacturer's Association (ECMA) is developing a standard for Computer Supported Telecommunications Applications (CSTA). The American National Standards Institute is developing a standard for Switch-Computer Applications Interface (SCAI). Both standards have the same purpose, namely to specify an architecture that is both service and implementation independent and to define a sufficient set of service elements and protocols to support a variety of shared applications between telecommunications and data processing environments. Both standards are nearing completion and should be approved within 1992.

Current Product Offerings

To be consistent with standards directions, any proposed product offering must define a well architected telephony services API which is independent of the platform on which it is implemented. The API should also be supported by a telephony services subsystem to provide the switch protocol mapping between the API and the various switches to which attachment is supported. This function of the telephony services subsystem allows application programs to communicate with multiple switches without being concerned with the unique interfaces and protocols of each switch. A brief overview is provided of the design considerations inherent in architecting a telephony services API and its underlying telephony services subsystem. This is followed by a more detailed description of the API structure and the solutions which are enabled by such an API.

Application Program Interface

A telephony services Application Program Interface (API) is designed to facilitate the communication between a host based application program and an attached switch or ACD unit. The API consists of a set of program calls which, when invoked by an application program, result in the execution of a supporting function in an underlying telephony services subsystem. The subsystem processes the program call and, if no errors are found, formats the request and communicates it to the attached switch or ACD. The API also consists of a set of messages which define call progress events or switch or communication line status. The

A directory number is the address used to identify a party. A directory number, however, does not uniquely identify a party's participation in a telephone call. To uniquely identify a party's participation in a given call, a connection ID must be created. The telephony services subsystem will create new connection IDs, as appropriate when a party, or an application program acting on behalf of a party, requests various services from a switch. The subsystem will also discard connection ID's, as appropriate, when other services are requested from a switch.

Telephone Connection States

As previously discussed, the model of a telephone call can be described in terms of parties and connections. It is now necessary to introduce the concept of "states" of a connection.

At any instant, a party's connection is in one of several states. The state that a connection is in determines what the next set of actions may be and whether a request involving that connection can be fulfilled. When a connection leaves a state, it makes a transition from that state to another. The following sections describe the 5 individual states that a connection within a telephone call can enter. These states are maintained by a switch for the parties local to that switch. When a switch receives a request, it is able to validate that any specified local party is in the correct state for the request to be fulfilled. If the request specifies remote parties (that is not local to the switch), the switch must send the request to the switch to which the remote party is connected for state validation and processing.

Idle State

There is no telephone call in process, and therefore no connection IDs representing this connection.

Pending State

An outgoing telephone call involving this calling party is being established. The calling party's connection enters this state when a call setup occurs. The call setup could be either the party's line going off-hook or the receipt by the switch of a Setup message from an ISDN phone. When the calling party's connection enters this state, a new connection ID is created to represent the calling party's connection into the pending telephone call. The calling party's connection leaves the Pending state and enters the Connected state when all the digits required to proceed with the telephone call have been collected by the switch.

Routing State

An incoming telephone call involving this called party is being routed to the party. The called party's connection enters this state when the validation of the calling party's dialed digits has been completed by the switch. When the called party's connection enters this state, a new connection ID is created to represent the called party's connection into the pending telephone call. The called party's connection leaves the Routing state and enters the Alerting state when the called party's identity and routing location have been determined by the switch and the switch has begun to alert the called party's phone.

Alerting State

An incoming telephone call involving this called party has been routed and the party's phone is being alerted by the switch. The alerting could take the form of a party's phone ringing or the sending of an Alerting message to an ISDN phone. The called party's connection enters this state when the alerting begins. The party's connection leaves this state when one of the following occurs:

- The call is answered, in which case the called party's connection enters the Connected state.
- The call is rejected, perhaps because a switch-specific time elapsed without the called party answering the call, or the calling party disconnects. In either case, the called party's connection ID that was created in the Routing state is discarded.

Transition Seven, From Alerting to Idle

A called party's connection passes from the Alerting to the Idle state if one of the following occurs prior to the incoming call being answered:

- The calling party disconnects
- The incoming call is rejected, perhaps as a result of a request from an application program.

Transition Eight, From Alerting to Connected

A called party's connection passes from the Alerting to the Connected state when the called party answers the incoming telephone call.

Transition Nine, From Connected to Idle

A party, regardless of whether the party was the called or calling party, passes from the Connected to the Idle state when its participation in the telephone call ends.

Program Calls

Application programs communicate with a switch by executing program calls. These program calls are used to exchange requests, responses, and other messages with the switch and to establish the characteristics to be associated with a telephone call profile.

Call Profiles

A telephony services subsystem will need to implement the concept of call profiles to allow it to provide a switch and device independent support to an application program. Through the use of call profiles a telephony services subsystem can maintain the unique characteristics of attached switches. The application program will need to initialize a call profile before communicating with a switch. It is possible that a program will use more than one call profile when communicating with a specific switch, but it will need at least one per switch.

Program Call Types

The program calls defined by the telephony services API will need to cover a range of functions, both for communicating with the attached switch and for requesting services from the telephony services subsystem. Although the list of supported program calls could be quite extensive it is clear from existing implementations that less than 50 program calls are needed to define an API that is capable of supporting programs to handle any aspect of a telephone call. A partial list of some common program calls that would be included in a telephony services API are described in the following:

Answer Call: Used by a program to alternate between two existing telephone calls, an active and a held call, by placing the active call on hold and retrieving the held call.

Disconnect: Used by a program to remove a party from its current call

Extend Call: Used by a program to extend an existing telephone call; that is, to place an existing call on hold and attempt a connection to another party.

Make Call: Used by a program to establish a telephone call

Monitor: Used by a program to register an interest in being sent specified call-progress event messages for a specified resource, such as a directory number.

Reject Call: Used by a program to reject an incoming telephone call that has been routed to a party.

Return Control: Used by a program to return control of a telephone call to the processing switch.

Operating Environment

Besides defining the program calls and messages to be used by an application program, a telephony services subsystem needs to provide mechanisms for system administrators to use in maintaining lists of resources available to the application programs. In the case of application programs which are managing telephone calls through one or more attached switches, these resources mostly consist of lists of directory numbers available to them and some means of identifying individual switches and their characteristics.

An application program, written to conform to an architected API, can be made independent of the unique protocols supported by a specific switch but it cannot be totally ignorant of the functions supported by that switch. One switch can support a different set of functions from another switch. This can be true whether considering different manufacturers or different switch types from one manufacturer or different levels of the same switch type from the same manufacturer. The application program should be designed and written taking the target switch and its supported functions into account. When the case occurs that an application program makes a request of a switch for a function that is not supported, this fact can be determined, to the greatest extent practicable, by the telephony services subsystem. Where it is not possible for the telephony services subsystem to make this determination, messages should be defined within the API to allow the switch to notify the program that it has requested a function that is not supported.

Enabled Solutions

Based on the availability of an architected Application Program Interface providing the level of functionality implied in the preceding sections, it is possible to implement application programs which can supplement the telephone call handling actions of a set of live agents. This capability automates and enhances many common business applications involving high volumes of telephone traffic. A few examples are described in the following sections.

Intelligent Answering

Intelligent Answering utilizes the capability of a telephony services application program to identify either the calling party, the called party, or both. This capability relies on one or more Network Services, such as Automatic Number Identification (ANI) or Dialed Number Identification Service (DNIS), but its real value comes from the ability of an application program to access customer information based on the numbers provided in the service. Once the number of a caller is passed to the application program from the switch, for example, the customer record database can be searched based on that number and any degree of relevant information can then be presented to the live agent at the moment of transfer. This information could be as straightforward as the customer's name (individual or company) or it could be a complete customer account history.

If only DNIS is being utilized, the information presented to the agent when the call is transferred could be pre-formatted order forms if the call is identified as being placed to the Sales Department or it could be claims forms if the call is being transferred to Customer Claims.

In either case, Intelligent Answering allows agents to answer the call in a more informed, personal manner. It also enables them to be more professional and productive. Since calls are handled more efficiently, more calls can be processed and customer holding time can be minimized. As a result, network costs for services, such as 800, can be reduced and telephone line utilization can be optimized or even reduced. All of this taken in total means that a company's overall responsiveness to its customers, vendors, and prospects is enhanced.

services API and its supporting subsystem an application program could determine the availability of multiple parties and establish a conference call. An agent could continue working until all parties were available.

Summary

This paper has described the customer environment involving the use of telephone based business transactions. It has proposed that the automation of these transactions, through the use of telephony service applications, can lead to multiple benefits to both the business employing these applications and to their customers.

The key to the automation of call handling, in many common business applications involving the use of telephone based transactions, is an architected, functionally rich telephony services application program interface. This API should provide an application programmer the ability to control all phases of a telephone call and automate as much as possible of the call handling process prior to handing off to a live agent. It should also relieve the programmer from being concerned with the individual protocols and interfaces of any attached switch or other telephone system. Such an API has been described and examples of the business solutions, which are enhanced by the use of applications based on this API, were provided.

Author Note and Copyright Information: It must be acknowledged that the concepts presented in this paper are based on IBM's Callpath Services Architecture. This is due to the authors corporate affiliation and familiarity with this proven architecture and related product offerings.

IBM continues to work closely with the aforementioned standards bodies and has made, as a stated design objective of Callpath Services Architecture, every attempt to ensure that minimal change, both to the API itself and to programs written to the API, should be required in order to communicate with a switch that supports the standardized protocols that are expected to be completed in the future.

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DIGITAL SOLUTIONS FOR MOBILE SATELLITE COMMUNICATIONS

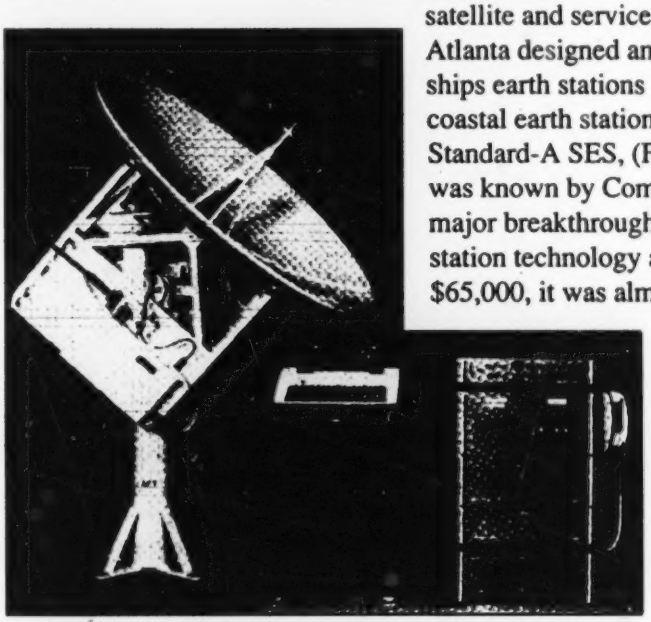
by Macy W. Summers, Director
Telecoms Business Development, Network Systems Group
Scientific-Atlanta, Inc.

Abstract: The 90's will be the decade of mobile satellite communications. INMARSAT's second generation birds are providing service to more than 14,000 users; Aussat will fly an L-band mobile transponder in 1992; Telesat Mobile (TMI) and American Mobile Satellite (AMSC) have the go ahead to construct their domestic mobile satellites. All of these satellite systems have tacitly agreed on common standards for digital mobile earth stations to provide low-speed data, fax, and compressed voice telecommunications to the mobile user community. This paper discusses a brief history of mobile satcoms and Scientific-Atlanta's mobile (MES) and land earth station (LES) family of terminals and systems.

Almost certainly, the decade of the 90's will be the blooming of Mobile Satellite Communications. The momentum that this adolescent industry has gathered is now unstoppable. Mobile digital earth stations are already under $8,000 and some are predicting high volume voice and data terminals in the $3,000 range by the late 1990's. This paper discusses the background of the mobile satellite industry and Scientific-Atlanta's (S-A) approach to the Geosynchronous Earth Orbit (GEO) mobile satcom and land earth station systems.

Background

In the early days of satellite communications, it was recognized by many that one of the enduring aspects of a satellite was its ability to reliably serve locations that were unreachable by traditional means. Ocean-going vessels and mobile vehicles far from the major metropolitan areas could be served by satellite as far in the future anyone could see. In 1975, Comsat General and Scientific-Atlanta began a collaboration for the commercialization of mobile satcoms. Comsat provided the MARISAT satellite and service. Scientific-Atlanta designed and built the ships earth stations (SES) and coastal earth stations (CES). The Standard-A SES, (Figure 1), as it was known by Comsat, was a major breakthrough in earth station technology and cost. At $65,000, it was almost ten times less expensive than the INTELSAT (fixed) single-channel voice terminal, and it included a stabilized pedestal to compensate for the roll and pitch movements of a ship in the open ocean. However, at $10/minute phone calls had to be of an urgent nature else



The world's first Mobile Earth Station, S-A Model 3055
Figure 1

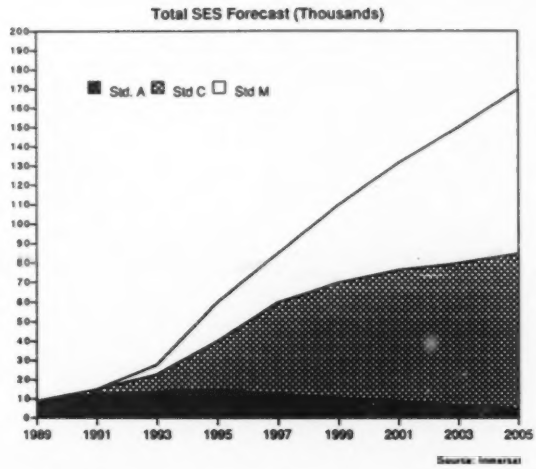
the cost of operating an SES might quickly outstrip the capital cost of the terminal.

Since that first mobile telephone call, made from a cargo vessel off the coast of Madagascar with an S-A Model 3055 MARISTAR® (SES), fifteen years of mobile satellite and terminal design experience have culminated in a new era of mobile services.

The second stage of mobile satellite came with the inception of INMARSAT. INMARSAT is somewhat patterned after the INTELSAT system and today has 64 member nations as its signatories. Although the International Maritime Satellite Organization was formally established in 1979, actual operation did not start until the Comsat joint venture, MARISAT, was turned over in 1982. Since that time, the INMARSAT earth station base has grown from approximately 1,500 to over 14,000, a compounded annual growth rate of over 25 percent.

INMARSAT's New Strategy

With the spectacular success of the INMARSAT service came some fundamental growing pains. Originally designed for 10,000, the four ocean region satellite service has now more than 14,000 SESs. In addition to the obvious satellite bandwidth and power implications, by the mid-1980's INMARSAT's service offering had become antiquated; analog voice and telex was not what the users wanted. SES prices had fallen to $35,000 each, but with C-Band (fixed) VSATs already under $10,000, SES users were complaining. New land mobile earth station (LMES) users wanted voice, fax, data and position reporting. Ship owners wanted on-line fleet management to aid in optimizing commodity shipment prices and costs of transportation. Yacht owners clearly wanted voice and weather reports. INMARSAT decided that what the market really needed was a wide range of telecommunications options to fit the specific



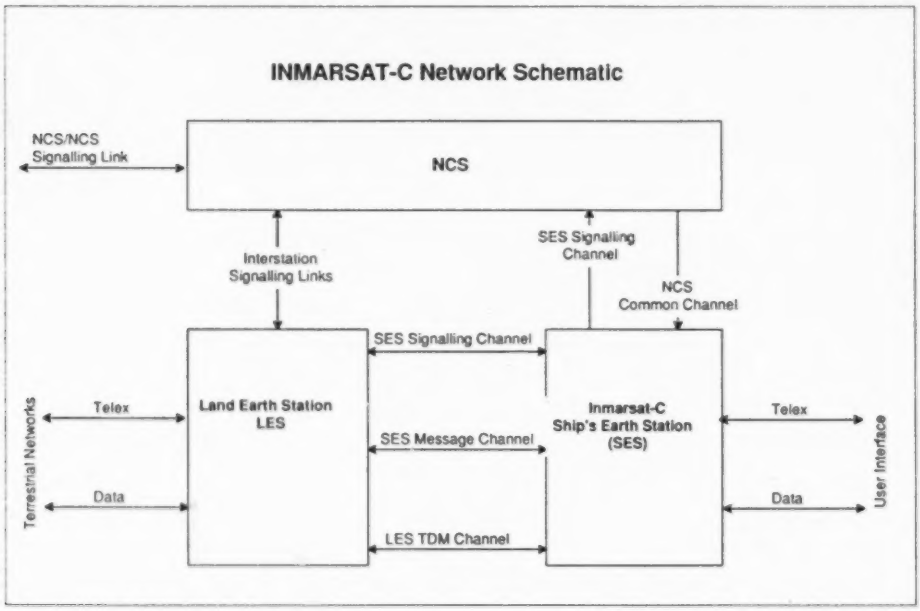
needs of their varied users. The strategy was to a) launch two new, higher power series of satellites(-2 and -3), b) completely phase out the analog services by 1995, c) introduce two new classes of digital telephony earth stations and d) one new data-only MES that could be made in volumes to sell for one-tenth of the original Standard-A. With these sweeping changes in place, INMARSAT was ready to grow again. The above Figure gives INMARSAT's SES growth projections.

INMARSAT also did not miss the opportunity to offer Aeronautical Mobile Satellite Services (AMSS). The global aviation industry, while much more conservative than their terrestrial bound counterparts, probably has the most to gain from satellite-based mobile communications. On long-haul transcontinental flights, Aeronautical Mobile Earth Station (AMES) passenger communications services could bring large growth revenues to a very competitive industry. So key is this segment of the mobile satcom market to the future revenues of INMARSAT that the INMARSAT-2 F1 bird (launched in March) has been positioned over the Indian Ocean Region (IOR) and will primarily carry air traffic control communications to aircraft through the UK and Singapore CESs. Most major transcontinental airlines have INMAR-

SAT trials underway and have plans to equip all long-haul aircraft with AMESs by 1996. One leading AMSS industry spokesman, Michel Gelinas, Vice President, Aeronautical Services, of IDB Aeronautical Communications, Inc. predicts "of the estimated 14,000 commercial aircraft globally, (he expects) equipping 30% of them at annual revenues of $2 billion in the year 2000."

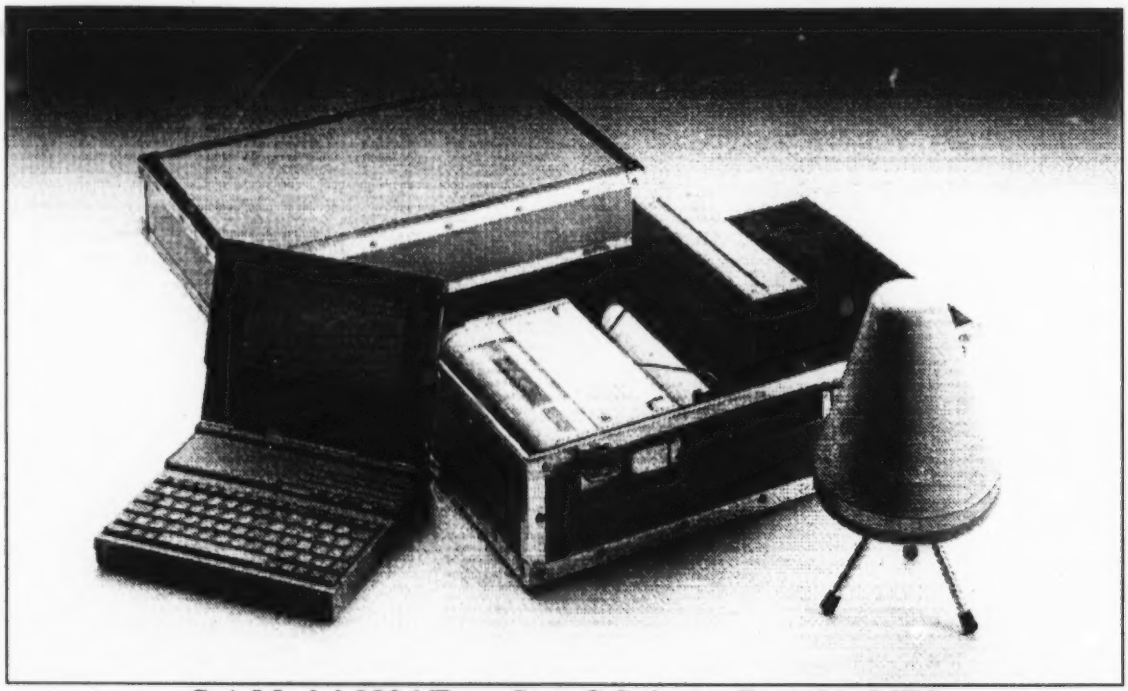
INMARSAT C, M, and B MESs

In 1989, INMARSAT-C (Inm-C) was announced to serve the low-end of the maritime and land mobile data markets. This store-and-forward, data-only "mobile VSAT" is typically connected with a PC or data terminal which formats the message to be sent. The Inm-C then sends packetized data to a LES through a slotted Aloha/reservation TDMA satellite channel where the message is switched into the public networks. (See the above Figure for the Inm-C network schematic diagram). The Inm-C immediately found acceptance in the targeted markets. Although some software and roll-out issues soured many of the initial trials, the market is now robust with more than 4,000 terminals and nine LES operational around the world.



INMARSAT-M is the next digital service offering in INMARSAT's strategy. Standard-M is a Demand Assigned Multiple Access (DAMA) SCPC digital telephony service that includes options for facsimile relay, and 2400 bps data. The voice coder is a 4.2 Kbps Improved Multi-Band Excitation (IMBE) algorithm that with FEC bits in the coder has a aggregate rate of 6.4 Kbps. This VoCoder has exceptional quality speech at low rates and can operate down to 10^{-2} Bit Error Rate. Although the Inm-M is not meant to be a direct substitute for the Inm-A, many LMSS users as well as vessels between 15 to 20 meters in length will find that the Inm-M will cater to their needs. The Inm-M will be introduced in early-to-mid 1992 and full four ocean region service will be available in mid-1993. The INMARSAT-M access control and signalling design is based on that adopted for INMARSAT-B. The target price of the "M" is $15-20,000 depending upon options and Land vs. Maritime version. Since some users will want SafteyNet or Telex services, INMARSAT believes that the combination of M&C will also be popular and at $22-28,000 many of the new ship builds will choose this configuration over Inm-A at $35,000.

INMARSAT-B is the direct replacement for Inm-A. This digital terminal is intended to be shipboard-only and consists of a 16 Kbps Adaptive Predictive voice coder. Telex,



S-A Model 9806 TerraStar-C Suitcase Portable MES
Figure 3

Group-3 Fax, and data up to 9.6 Kbps are also standard features of the "B". The projected price for the Inm-B is $40,000. To allow existing users of Inm-A terminals to fully utilize their investment, INMARSAT has restated its policy to support Inm-A services until at least 2005. INMARSAT will allow new commissionings of Inm-A SESs for a minimum of three years after the introduction of INMARSAT-M/B (i.e., until 1995/1996 at least).

Regional Systems

The third stage of mobile satcoms development began with the idea that regional mobile services could be introduced. In the mid-1980's it became apparent that earth terminal developments in digital and RF technologies for Fixed Service Satellite (FSS) earth stations could be utilized in Mobile Satellite Services (MSS). Geostar Corporation found a market for Radio Determination Satellite Services (RDSS) using L- and S-band spectrum by providing position location information to US trucking and transportation operators. Qualcomm soon followed suit but utilized Ku-band. These two market entries marked the watershed for INMARSAT's MSS monopoly: Regional systems were feasible and users accepted them. A series of failed spacecraft launches and equipment problems eventually forced Geostar into bankruptcy in mid-1991. Qualcomm remains and is growing very rapidly with now over 14,000 vehicles equipped with RDSS and low-speed messaging mobile earth stations.

The national/regional systems that are planned for the near future are:

-AMSC (USA)
-TMI (Canada)
-AUSSAT (Australia)

All of these separate systems have loosely standardized on the INMARSAT terminal specifications. All use the Digital Voice

Systems, Inc. 6.4 Kbps codec for the low-cost telephony MES and all have allowed for Inm-C type services. These forward thinking developments allow manufacturers to have economies of scale thus passing on cost savings to the users in the form of lower MES prices. It is thought that the voice-only MES could be as low as $3,500 by the year 2000.

One other separate system to be considered is the Soviet MSS. The Soviet Union certainly has a great need for land mobile satellite services. Currently, there are two L-Band satellites in orbit providing service to the Moryasputnik user base of primarily SESs. Moryasputnik is a member of INMARSAT and a homogenization of services and satellites may be a forthcoming development.

Future Developments

What is next for the mobile satellite industry? The direction seems to be in the direction of Motorola's bold 77 Low Earth Orbit (LEO) "Iridium" satellite constellation for personal telephone communications. Another proposal is the ORBCOMM system from Orbital Sciences, Inc. that uses low-cost hand-held messaging terminals. Given that the technology of satellite-to-satellite links, on-board switching, and "upside down" cellular hand-off exists, we may see operational LEO satellite systems by the turn of the century.

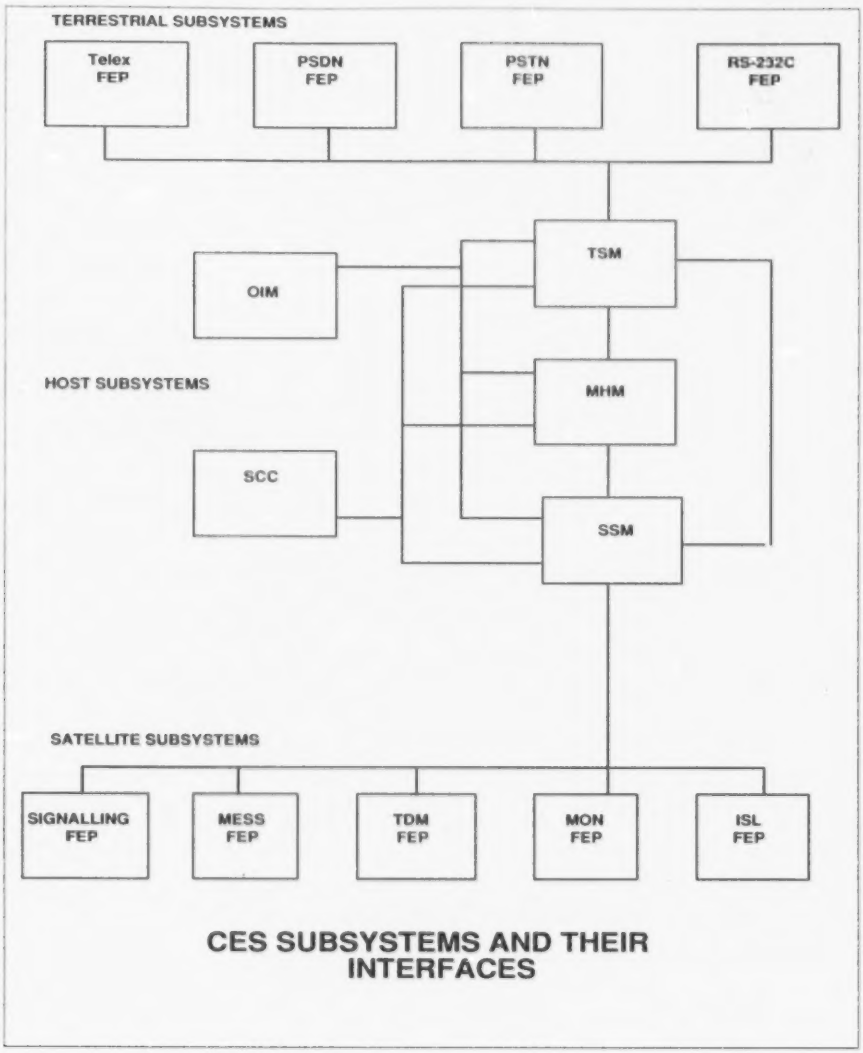
S-A Mobile Earth Station Systems

Scientific-Atlanta's pioneering involvement in mobile satcoms has now come full circle. S-A is again leading the world's development in INMARSAT digital telephony MESs and is investing large sums of research and development dollars into these new digital services. S-A's **MariStar**, **TerraStar** and **AeroStar** product lines are the most complete of any MES equipment provider. Additionally, Scientific-Atlanta can provide the complete, turnkey Land Earth Stations needed for the new C, M, and B digital services.

S-A's product line categories are delineated by their application. The shipboard (or maritime) earth stations are called MariStar. The TerraStar terminals are used for land mobile applications such as transportation (trucking, rail, etc.). Finally, S-A's AeroStar products are designed for commercial and general aviation aircraft applications. Table 1 shows the current Scientific-Atlanta digital MES product offerings.

Category	Class	Model No.	Description
MariStar	C	9801	Data-only SES (GPS option)
MariStar	M	9821	Voice, Fax, Data SES (GPS option)
TerraStar	A	9811	Suitcase Portable Inm-A
TerraStar	C	9805	Land mobile Inm-C (GPS option)
TerraStar	C	9806	Suitcase Portable Inm-C
TerraStar	M	9831	Land mobile Inm-M (GPS option)
AeroStar	C	9881	Air mobile Inm-C, doppler buffer (GPS option)

Scientific-Atlanta Digital MES Products
Table 1



CES SUBSYSTEMS AND THEIR INTERFACES

The LES systems from Scientific-Atlanta are designed for high reliability and flexibility. The architecture of the digital LES is one that allows an operator to start with Inm-C services, upgrade in a year or so to M, then as Inm-B comes on line, only channel units and additional procession need to added. Each subsystem is connected by two-zone, fault-tolerant DEC VAXft 3000 mini-computers, three 381 Mbyte disc drives, a 290Mbyte cartridge tape drive, and a dual (redundant) IEEE 803.2 Ethernet bus connecting each channel unit and Front-End Processors (FEP). FEPs serve each type of channel on the satellite side as well as each possible public (or private) network connection on the terrestrial side. Additionally there are dedicated FEPs for Interstation and Network Operations Center Signalling Links.

Each category of S-A's MESs are further subdivided into classes. The class correspond to INMARSAT's system definitions. These broadly define the communications capabilities available to the user of the MES. Lastly, the Model number is Scientific-Atlanta's generic classification of a single MES. However, each MES can be fitted with several options so there are dash and letter configurations after the model number that define the precise MES. Figure 3 shows the Scientific-Atlanta TerraStar-C Suitcase Portable MES.

In summary, mobile satellite communications has had a strong history of growth and innovation. A bright future lies ahead for INMARSAT and the regional mobilesat operators. New, low-cost digital MESs and LESs are available now from Scientific-Atlanta; the pioneer in mobile satellite communications.

Information Infrastructure

Pekka Tarjanne, Secretary-General
International Telecommunication Union
Geneva, Switzerland

Abstract

Today, the challenge in implementing and evolving telecommunications is being treated in very different terms. Telecommunications is increasingly being approached in the larger and much broader context of information infrastructure and economic growth. Getting that infrastructure into place and maximizing national and regional economic growth are the basic objectives; and how it is done is becoming secondary. This is resulting in the removal of barriers to competitive entry into telecommunication facilities and provisioning markets on a global scale, and opening the floodgates to infrastructure development.

What does this emerging infrastructure look like? While the details are not clear, the general form is. At the lowest layers, there are ever more numerous kinds of terrestrial and satellite facilities which provide cheap basic digital pipes to every corner of the world - a kind of newly emerging "global backplane." This backplane then supports the real innovation - the innumerable webs of networks and applications for every sector of business and society - the application communities. These communities, who have the ability to take the information tools and use them to meet their needs are a particularly critical part of infrastructure today, and providing them with low-cost tools is a necessary part of infrastructure. And lastly there is the need for new regulatory regimes that allow market-open competitive entry into the marketplace at national, regional and global levels, and that maintain effective competition.

The result should spur continued innovation and growth in economic, social and individual terms without parallel in human experience.

I would like to weave together many developments taking place today - just as you have done in your agenda for the Conference - and concentrate on a few "cosmic" developments: namely that telecommunication itself is being treated in fundamentally different ways and that new kinds of global information infrastructures are emerging.

Telecommunication: fundamentally different treatment

In 1991 - like the past few years - we witnessed profound change. Indeed, when we reflect on the evolution of the U.S.S.R. into the Commonwealth of Independent States, or the potential for a meaningful peace process in the Middle East, or the worldwide shifts toward more robust competitive economic systems, telecommunications developments seem to pale into insignificance. Even the continuing attempts taking place to surmount potential trade barriers in the GATT, and bring about a GNS, has the potential for profoundly affecting the global economy.

Telecommunications, however, are not entirely isolated from all these developments. Most people realize that telecommunications have played a significant role in bringing about these changes. And on the other side of the coin, telecommunications are being irreversibly affected by them as well. For example, at a *Financial Times* telecommunications conference a few weeks ago, one of the speakers noted that between 1990 and 1995, the number of telephone exchange lines operated by private companies worldwide will shift from 50 percent to 80 percent. During the past few years, we have witnessed most telecommunications making the shift from a rigid government monopoly offering to the business of competitive enterprise.

This does not mean, on the other hand, that government is no longer interested in the development and evolution of telecommunications. Certainly the amount of regulatory oversight necessary to assure fair, competitive playing fields has not diminished. In addition, the role of government in funding critically important infrastructure was certainly underscored when the Gore Bill was adopted in the closing days of the last U.S. Congress to fund the development of an entirely new generation of "gigabit networking" as well as the use of the Internet as a universal collaborative "knowledge" fabric. What this all means is that the role of governments - if not intergovernmental cooperation - is in the process of rapid change in the telecommunications field.

Of course, technology also continues to play a major part in this transition. One of our keynote speakers at the Telecom-91 Regulatory Symposium pointed out that the dramatic changes in transmission technologies have brought us many new networks all over the world. People have been able to build entirely new "instant networks." It has enabled the instant digitalization of long-haul networks.

Even more amazing is that none of this shows any sign of stopping. The speed that fiber is capable of is dou-

bling every year. What does this mean to regulation and competition in the business? It's not going to become a free resource. But it will become independent of distance - and eventually almost independent of bandwidth. Increasingly, the cost will be in access, administration and billing, not the technology. As a result, one of the highest profile developments in the ITU today involves the attempts to move the price of international communication more in line with real costs, and to do so on a basis that doesn't discriminate among countries.

Along similar, but perhaps even more unexpected lines, the cost of building intelligent devices using computers continues to plummet. This continues to change the entire architecture of telecommunications. For example, one of the more significant issues in the U.S. today is access to "dark fiber" so that more of the ultimate capacity of the fiber can be used directly.

As this trend continues, more and more value-added processing is moving external to the networks. In many respects, the integrated circuit revolution is sucking the intelligence out of the networks, just as the Personal Computer has sucked much of the intelligence out of mainframes and put it on the desk. This allows for all kinds of new network capabilities to be put into place very quickly without having to wait for any kind of central coordination or control. It is also resulting in enormous investments in private networking infrastructure - especially in Local and Wide Area Networks - whose massive growth over the next few years in the telecommunications field will only be matched by mobile communications networks and services.

It is not surprising then that telecommunications is being approached in the larger and much broader context of information infrastructure and economic growth. Getting that infrastructure into place and maximizing national and regional economic growth are the basic objectives; and how it is done is becoming secondary. This is resulting in the removal of barriers to competitive entry into telecommunication facilities and provisioning markets on a global scale. Through a variety of means - ranging from competitive global end-to-end provisioning to innumerable joint ventures - telecommunications provisioning, access and use have become a competitive global business playing by *de facto* trade-in-services rules, even if a GATT-GNS agreement pertaining to telecommunications does not yet exist.

Last year, for example, one of the more notable achievements at the international level was a revised CCITT Recommendation D.1 on the significantly liberalized provisions on the availability and use of private leased lines. Some of the participants in both the CCITT and the GATT discussions were the same people who, with surprising ease, simply made the transition from one international body to another to further the evolution of the same language and norms, and then several months later at Telecom-91 reflected on the whole experience.

In the process of dropping the barriers to entry into telecommunications provisioning, the floodgates to information infrastructure development are being opened. As we embark upon 1992 and move further into a remarkable new decade of globalization, "dropping the barriers" in so many ways seems like a permanent and productive trend.

It seems to me, however, that a great deal of work remains to be done. For example, the differences in open network approaches of different nations and regions portend a major need to harmonize these approaches in the coming years.

In addition, the increasing tendency to proceed with standards making activities in more diverse industrial, regional, and national forums will enhance the importance of timely, easy, and fully open access to standards and standards making processes. The open "networking" of standards that was so successfully demonstrated by the ITU late last year in making CCITT Recommendations available on servers throughout the world, needs to be replicated for all standards making institutions.

The Shape of the Infrastructure

It is fair to ask - or at least to explore - what this emerging information infrastructure may look like? While the details are not clear, we know courtesy of Peter Huber what the general form is - geodesic. However, unlike the geodesic dome, but perhaps more like Unix Kernels, this structure consists of onion-like layers.

At the lowest layers, there are ever more numerous kinds of terrestrial and satellite facilities which provide cheap basic digital pipes to every corner of the world - a kind of newly emerging "global backplane."

However, I do believe that portions of this backplane will have significant built-in intelligence - typified by the Intelligent Network efforts now underway in the CCITT and other places around the world. The quandary confronting us pointed out by a recent commentator who noted that "although we all want access to the whole world from wherever we are, we don't want the whole world to have access to us." It is going to take a certain amount of our own intelligence, combined with a lot of network intelligence to sort out these problems and provide the right kind of connectivity or "non-connectivity" through various technical and social filters.

It will be this backplane that supports the real innovation - the innumerable dynamic webs of networks and applications for every sector of business and society - the application communities. In the past, these communities were called "users." Somehow this doesn't seem adequate today. Maybe the term "customer" is better - but still fails to convey the degree of interactive control provided. Maybe the right term hasn't yet been invented.

In any case, these communities have the ability to take the information tools and employ them to meet their needs. They are a particularly critical part of infrastructure today, and providing them with low-cost tools is a necessary part of information infrastructure.

In the future, I believe this aspect of information infrastructure will receive increasing attention. Certainly the famous U.S. National Research and Educational Network initiative and its counterparts throughout the world, are significant attempts to get beyond just having the tools available. The problem is that the tools have become available faster than our human social systems can make use of them. As a result, we frequently have large segments of populations, professions and institutions in every country - from the most affluent to the poorest - which can become more efficient and effective, by using the available tools and those who cannot....or will not.

Where is the nearest accessible EMail terminal? How many people at this meeting effectively collaborate through electronic networks? Why can't those who are unable to come to this meeting access the papers electronically? Why can't I easily use my mobile phone or laptop PC modem here at the meeting? I think the answers to these questions go to the heart of a significant problem we are facing today. The tools are there, but changing people's cultures is not so easy. But perhaps next year, we will be able to register for PTC-93 electronically!

* * *

Although there may be impediments, and the precise implementations are unclear, the general directions toward an emerging information infrastructure are rather apparent. The genuinely exciting news is that the result should spur continued innovation and growth in economic, social and individual terms without parallel in human experience.

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PTC' 92

14TH PACIFIC TELECOMMUNICATIONS CONFERENCE

SHERATON WAIKIKI HOTEL, HONOLULU, HAWAII

JANUARY 12 - 15, 1992

ADDRESS BY HONOURABLE DATO' SERI S. SAMY VELLU, MINISTER OF ENERGY, TELECOMMUNICATIONS AND POSTS, MALAYSIA

LADIES AND GENTLEMEN,

I AM INDEED GREATLY HONOURED AND PRIVILEGED TO HAVE BEEN INVITED TO ADDRESS THIS DISTINGUISHED GATHERING OF POLICY MAKERS AND PROFESSIONALS OF THE TELECOMMUNICATIONS INDUSTRY IN THE PACIFIC HEMISPHERE.

I MUST ALSO THANK THE ORGANIZERS OF THE CONFERENCE FOR THE OPPORTUNITY GIVEN TO ME AND MY DELEGATION TO PARTICIPATE IN THIS MEETING WHICH IS RECOGNIZED AS THE PREMIER CONFERENCE COVERING THE LATEST DEVELOPMENTS AND PROPOSALS IN TELECOMMUNICATION SYSTEMS AND SERVICES FOR THE PACIFIC REGION.

LADIES AND GENTLEMEN,

IT IS NEEDLESS TO SAY THAT EFFECTIVE AND RELIABLE TELECOMMUNICATIONS IS A PREREQUISITE FOR ECONOMIC DEVELOPMENT, GLOBAL TRADE AND FOREIGN INVESTMENT. THIS IS VERY EVIDENT IN MY COUNTRY, MALAYSIA, WHERE EXPANDING TELECOMMUNICATION CAPABILITIES HAVE GONE HAND-IN-HAND WITH RAPID ECONOMIC GROWTH.

A COHERENT GOVERNMENT POLICY ON PRIVATIZATION HAS PROVIDED THE IMPETUS CRUCIAL TO THE DEVELOPMENT OF TELECOMMUNICATIONS IN MALAYSIA. THE MALAYSIAN TELECOMMUNICATIONS INDUSTRY TODAY IS THE RESULT OF A LIBERALIZATION PROCESS THAT HAS LEFT AN INDELIBLE MARK ON THE STRUCTURE OF THE INDUSTRY WHICH CAN BE TRACED BACK TO 1983 WHEN THE GOVERNMENT DECIDED TO OPEN UP PAGING OPERATIONS TO

LOCAL LICENSEES. THE TURNING POINT CAME IN 1987 WHEN THE TELECOMMUNICATIONS DEPARTMENT WAS CORPORATIZED CREATING TELEKOM MALAYSIA, THE FIRST GOVERNMENT UTILITY TO BE TRANSFORMED UNDER A PUBLICLY ANNOUNCED PRIVATIZATION PLAN.

TELEKOM MALAYSIA OPERATES AN INTEGRATED NETWORK FOR THE RESERVED TELEPHONE, LEASED LINE, TELEX, PACKET SWITCHED AND CIRCUIT SWITCHED SERVICES. THE NATIONWIDE TELEPHONE SERVICE FOR THE PRESENT 1.6 MILLION CUSTOMERS IS PROVIDED BY A NETWORK OF 562 TELEPHONE EXCHANGES, OF WHICH 315 ARE DIGITAL. THE TRUNK MICROWAVE NETWORK CONSISTS OF BOTH ANALOGUE AND DIGITAL SYSTEMS. SOME 407 MICROWAVE STATIONS MAKE UP THE ANALOGUE MICROWAVE TRUNK NETWORK, WHILE 235 STATIONS MAKE UP THE RECENTLY COMMISSIONED DOMESTIC DIGITAL MICROWAVE NETWORK. FIBRE OPTICS HAVE ALREADY BEGUN TO BE LAID IN SELECTED SHORT-HAUL INTRA-CITY ROUTES, PARTICULARLY IN THE BUSINESS AND FINANCIAL CENTRES. PLANS ARE AFOOT TO EXPAND THE USE OF FIBRE OPTICS IN BOTH THE OVERLAND AND SUBMARINE TRUNK NETWORK. THE FIRST OPTICAL FIBRE SUBMARINE CABLE TO BE OPERATIONAL IN THE ASEAN REGION LINKING KUANTAN AND KOTA KINABALU PROVIDES A QUANTUM LEAP IN QUALITY AND CAPACITY. THIS COMMISSIONING WAS CRUCIAL TO BRINGING THE VISION OF A NATIONWIDE INTEGRATED DIGITAL NETWORK CLOSER TO REALITY. THE INTERNATIONAL GATEWAY SWITCH AT KUANTAN HAS HELPED THE GROWTH OF INTERNATIONAL TRAFFIC TO AND FROM MALAYSIA.

WITH A GROWTH RATE OF 14 PER CENT IN THE TELEPHONE SERVICE IN 1990, THERE IS SUFFICIENT MOMENTUM AND POTENTIAL IN THE MARKET FOR THIS LEVEL OF GROWTH TO BE MAINTAINED DOUBLING

THE SUBSCRIBER BASE TO 3.2 MILLION BY 1995. THE OPPORTUNITIES FOR MARKET DEVELOPMENT ARE IMMENSE, AS THE MARKET IS CHARACTERIZED BY HIGH GROWTH AND LOW PENETRATION LEVELS WHICH HAS ACHIEVED A FIGURE OF 9 ACCESS LINES PER 100 POPULATION BY END-1990 AND THIS IS EXPECTED TO RISE TO 15 BY 1995. WHILE THIS IS THE GROWTH SCENARIO PROJECTED DOMESTICALLY, ITS IMPACT ON INTERNATIONAL TELEPHONE TRAFFIC IS EXPECTED TO BE TREMENDOUS. STEADY GROWTH IN THE REGION OF 35 PER CENT HAS BEEN THE ORDER OF THE DAY IN THE LAST FOUR YEARS, THE TOTAL VOLUME BEING 181 MILLION MINUTES LAST YEAR. TO MEET THESE GROWTH SCENARIOS, HEAVY INVESTMENTS WILL BE CHANNELLED INTO THE NETWORK TO MEET BOTH MARKET GROWTH AND ENHANCE NETWORK QUALITY AND US$1.2 BILLION IS EXPECTED TO BE SPENT ON CABLE, SWITCHING AND TRANSMISSION NETWORKS. INTERNATIONAL COMMUNICATIONS WILL ALSO BE ENHANCED IN THE NEAR FUTURE WITH THE INSTALLATION OF TWO ADDITIONAL INTERNATIONAL GATEWAYS TO BE LOCATED IN KUALA LUMPUR.

THE GOVERNMENT AIMS TO ENDOW THE NATION WITH A SYSTEM OF TELECOMMUNICATIONS COMPARABLE WITH THAT OF DEVELOPED COUNTRIES BY THE END OF THE DECADE. IN ANTICIPATION OF NEW AND INTELLIGENT SERVICES THAT WILL BE IN DEMAND, THE NETWORK IS BEING PREPARED FOR THE INTRODUCTION OF COMMON CHANNEL SIGNALLING NO. 7. CCS 7 PLANNING WILL BE INCORPORATED INTO REGULAR EXPANSION AND DIGITALIZATION PROGRAMMES WHERE FULL DIGITALIZATION OF THE NETWORK IS EXPECTED TO BE ACHIEVED BY 2000.

VARIOUS INITIATIVES HAVE BEEN PLANNED AND MADE

OPERATIONAL TO ACHIEVE EXCELLENCE IN CUSTOMER SERVICE AND NETWORK QUALITY. AN AUTOMATED CUSTOMER COMPLAINTS SYSTEM WHICH SPEEDS UP SERVICE RESTORATION WAS ESTABLISHED IN OCTOBER 1990. THE SYSTEMS FOR TESTING AND ADMINISTRATION FOR REPAIR SERVICES (STARS) WILL BE EXTENDED NATIONWIDE IN STAGES. FOR BUSINESS CUSTOMERS WHO USE DATA SERVICES AND LEASED LINES, SERVICE QUALITY WILL BE CENTRALLY MONITORED AND MANAGED USING THE MANAGED LEASED CIRCUIT NETWORK (MLCN). THE SYSTEM WILL PROVIDE CENTRAL SUPERVISION AND CONTROL, ALLOW REMOTE SET-UP, PROVIDE AUTOMATIC RE-ROUTING IN THE EVENT OF CIRCUIT FAILURE, PROVIDE PART-TIME DIGITAL LEASED CIRCUITS, AND OFFER FACILITIES FOR DISASTER RECOVERY CENTRES. FOR OVERALL NETWORK QUALITY, A NETWORK MANAGEMENT SYSTEM (NMS) IS ALSO BEING DESIGNED TO ENSURE EFFICIENT OPERATION THROUGH REAL-TIME TRAFFIC MANAGEMENT.

THE RANGE OF SERVICES OFFERED IS VARIED, COVERING SPECIALIZED AND BUREAU SERVICES, DATA COMMUNICATIONS, RADIO AND MOBILE SERVICES, AND VARIOUS INTERNATIONAL, VOICE, TEXT AND VALUE-ADDED SERVICES. AMONGST THE INTERNATIONAL SERVICES OFFERED ARE THE INTELSAT BUSINESS SERVICE (IBS), INMARSAT, VOICECASTS AND TELECASTS. APART FROM THESE THE NATIONAL PACKET-SWITCHED SERVICE, MAYPAC AND OTHER LEASED SERVICES SUCH AS DIGITALINE ALSO OFFER HIGH SPEED DATA CIRCUITS TO INTERNATIONAL DESTINATIONS. INTERNATIONAL DIRECT DIALLING (IDD) SERVICE IS AVAILABLE TO A TOTAL OF 178 DESTINATIONS WORLDWIDE. VARIOUS NEW SERVICES SUCH AS CENTREX, ADVANCED 800, VIDEO CONFERENCING AND ISDN FACILITIES ARE BEING MADE AVAILABLE. THESE INTELLIGENT NETWORK SERVICES WILL ALLOW

USERS TO CUSTOMIZE SERVICES DIRECTLY THROUGH THEIR TERMINALS. THESE SERVICES PROVIDED SUPPORT FOR THE PROGRESSION OF THE ECONOMY TO ONE BASED ON MANUFACTURING AND SERVICES. THROUGH THESE SERVICES, GREATER DEPTH IS ADDED TO INTERNATIONAL OPERATIONS LOCATED IN MALAYSIA, PARTICULARLY IN THE FINANCE AND MANUFACTURING AREAS. CUSTOMERS HAVE A VARIETY OF SERVICES TO SUBSCRIBE TO, ECONOMIZING THEIR RESOURCES AND OPTIMIZING BENEFIT IN THE PROCESS. FOR OTHERS, SOME OF THESE SERVICES PROVIDE THE COMPETITIVE EDGE SOUGHT IN THEIR LINE OF BUSINESS.

THE GROWTH TREND OF MOBILE COMMUNICATIONS WILL ACCELERATE IN THE 1990S AS USERS ARE INCREASINGLY FLEXIBLE AND MOBILE IN THEIR BUSINESS ACTIVITIES AND LIFESTYLES. MOBILE COMMUNICATIONS WERE AVAILABLE TO THE MALAYSIAN PUBLIC IN 1964 WHEN PUBLIC CORRESPONDENCE NETWORK (PCN) WAS LAUNCHED. THIS WAS A RADIOTELEPHONE SERVICE THAT WAS AVAILABLE TO CUSTOMERS RESIDING WITHIN A 30 KM RADIUS OF KUALA LUMPUR. TODAY, WE HAVE 2 CELLULAR SYSTEMS WHICH ARE IN OPERATION, 3 ACTIVE TRUNK RADIO OPERATORS, 3 LICENSEES ON CT-2 DIGITAL CORDLESS AND SOME 20 OVER PAGING OPERATIONS. THERE IS A RANGE OF SERVICES AVAILABLE TO THE MALAYSIAN USER AND FINAL CHOICE IS DICTATED BY ONE'S OWN COMMUNICATION NEEDS IN TERMS OF FUNCTIONALITIES, SECURITY AND PRIVACY OF SPEECH, QUALITY OF SERVICE AND THE PRICE ONE IS WILLING TO PAY FOR.

APART FROM ALL THIS SOPHISTICATED NEW TECHNOLOGY IN THE FIELD OF TELECOMMUNICATIONS, THERE IS THIS IMPORTANT ASPECT OF REGULATION.

LADIES AND GENTLEMEN,

THE EIGHTIES WILL BE REMEMBERED AS A DECADE OF REMARKABLE CHANGES IN THE WORLD OF TELECOMMUNICATIONS. THE CHANGES RESULTED FROM THE IMPLEMENTATION OF A NEW POLITICAL PHILOSOPHY AT A TIME WHEN TECHNOLOGY WAS DEVELOPING RAPIDLY. THE PIVOTAL EVENTS WERE THE PRIVATIZATION OF THE PTT'S IN VARIOUS COUNTRIES, INCLUDING MALAYSIA. AFTER THE CORPORATIZATION AND EVENTUAL PRIVATIZATION OF THE PTT IN MALAYSIA, THE GOVERNMENT RETAINED THE REGULATOR FUNCTIONS UNDER THE DEPARTMENT OF TELECOMMUNICATIONS. TO THIS END, LIBERALIZATION AND PRIVATIZATION RAISE ISSUES OF THE MANAGEMENT OF CHANGE. EACH NATION HAS A DIFFERENT SET OF VALUES, CIRCUMSTANCES AND PRIORITIES THAT DICTATE THE NATURE OF THE CHANGES AND THE RATE AT WHICH THEY SHOULD OCCUR. THESE CHANGES MUST BE MANAGED AND REGULATED IN A TIMELY MANNER.

THERE HAVE BEEN THREE CLOSELY INTER-RELATED LINES OF DEVELOPMENT:-

1. *THE FUSION OF TELECOMMUNICATIONS AND COMPUTERS RESULTING IN AN ARRAY OF INFORMATION TECHNOLOGIES AND NEW SERVICES;*

2. *LIBERALIZED, COMPETITIVE ENVIRONMENT SPEEDS UP THE RATE OF CHANGE AND TENDS TO IMPROVE THE PERFORMANCE OF THE PRIVATIZED MONOPOLY;*

3. *USERS ARE DEMANDING FOR THE BEST SERVICES AND AT*

COMPETITIVE PRICES.

IN MALAYSIA, THE TELECOMMUNICATIONS ACT SETS THE FRAMEWORK FOR THE REGULATION OF TELECOMMUNICATIONS IN THE COUNTRY. IN THE FIVE YEARS THAT HAS PASSED, MUCH HAS HAPPENED TO DEMONSTRATE THAT THE EXPECTATIONS OF THE PRIVATIZED COMPANY AND THE GOVERNMENT DIFFER IN MANY WAYS AND IN CERTAIN RESPECTS THESE DIFFERENCES ARE OF A FUNDAMENTAL NATURE. I WOULD THEREFORE RECOMMEND TO ANY COUNTRY ON THE VERGE OF PRIVATIZATION TO MAP OUT CLEARLY THE POLICIES APPLICABLE IN THE PRIVATIZED ENVIRONMENT AND THE DIRECTION FOR THE PRIVATIZED COMPANY IN ORDER TO AVOID THESE DIFFERENCES.

THERE IS A NEED NOW TO SPELL OUT THE FUTURE COMPETITION POLICY TO TAKE THE TELECOMMUNICATIONS INDUSTRY ALL THE WAY TO 2020 WHEN WE PLANNED TO BE INDUSTRIALIZED. IN CHARTING FUTURE COMPETITION POLICY FOR THE BASIC SERVICES THE FACTORS OF:

1. THE SIZE OF THE PRESENT NETWORK;

2. THE TECHNOLOGIES THAT ARE BEING DEVELOPED;

3. ECONOMIES OF SCALE;

4. DUPLICATIONS OF RESOURCES AND NETWORKS.

MUST BE TAKEN INTO CONSIDERATION. AFTER REVIEWING THE ABOVE, THE MOST VIABLE FORM OF COMPETITION WOULD BE TO USE

THE WIRELESS TECHNOLOGIES TO COMPETE AGAINST THE WIRED NETWORK.

FOR THE NON-BASIC OR NON RESERVED SERVICES, INCLUDING VALUE ADDED SERVICES, THE POLICY WILL BE TO PROMOTE COMPETITION AND TO REMOVE BARRIERS TO MARKET ENTRY IN ORDER TO INCREASE THE VARIETY AND QUALITY OF SERVICES AVAILABLE TO THE CONSUMERS. THESE SERVICES WILL PROMOTE THE FORMATION OF THE "INFORMATION SOCIETY" AND ALSO PROVIDE A COMPETITIVE EDGE TO OUR INDUSTRIES. THERE IS ALSO A NEED TO DEFINE THE PRICE CONTROL MECHANISM ESPECIALLY FOR THE BASIC SERVICES. THE RATE OF RETURN MECHANISM AND THE PRICE CAP MECHANISM HAVE BEEN CONSIDERED AND THERE IS A LIKELIHOOD THAT THE LATTER WILL BE ADOPTED. PRICES ARE LINKED TO THE QUALITY OF SERVICES AND THEREFORE THERE IS A NEED TO MONITOR AND TO ENFORCE QUALITY OF SERVICE STANDARDS. QUESTIONS LIKE WHETHER THE MONOPOLY IS BEING RUN EFFICIENTLY AND AT WHAT RATE OF RETURN IS JUSTIFIABLE IN A MONOPOLISTIC ENVIRONMENT WILL HAVE TO BE ADDRESSED. THE FUNCTIONS OF THE REGULATORY BODY ALSO INCLUDES TECHNICAL REGULATIONS SUCH AS:-

1. *ESTABLISHMENT OF TELECOMMUNICATION STANDARDS AND THEIR ENFORCEMENT;*

2. *INTERCONNECTIONS BETWEEN NETWORKS; AND*

3. *INTERFACES AND CONNECTIVITY, NUMBERING SCHEME AND FUNDAMENTAL PLANS.*

TECHNICAL REGULATIONS HAVE BECOME INCREASINGLY COMPLEX AND THE MORE NETWORK LICENCES ARE ISSUED, THE GREATER WILL BE THE INTERCONNECTION COMPLEXITY. THE INTERCONNECTIONS BETWEEN NETWORKS HAVE TO BE PLANNED, REGULATED AND POLICIES FORMULATED IN ORDER TO ENSURE EFFICIENT CONNECTIVITY.

THE DEVELOPMENT OF RADIO COMMUNICATION BASED NETWORKS DURING THE LAST FEW YEARS HAS BEEN TREMENDOUS AND THE DEMAND FOR FREQUENCY SPECTRUM IS REACHING NEW HEIGHTS. END USERS LICENSING FOR RADIO COMMUNICATIONS APPARATUS HAS BEEN A MAJOR TASK ESPECIALLY AFTER PRIVATIZATION DUE TO THE HUGE INCREASE OF USERS. A VARIABLE FEE STRUCTURE MAY BE INTRODUCED, BASED ON THE SERVICE CAPACITY AND REVENUE PRODUCING CAPACITY OF THE FREQUENCY ASSIGNED AND THESE WILL BE ADDRESSED IN THE NEW RADIO COMMUNICATION REGULATIONS.

THE PROMOTION OF A LIBERALIZED, COMPETITIVE ENVIRONMENT WILL CERTAINLY SPEED UP THE RATE OF CHANGE. AS MANAGERS OF CHANGE WE HAVE TO ENSURE THAT THE CHANGE IS MANAGED FOR THE BENEFIT OF THE NATION AND I BELIEVE THAT OUR COUNTRY IS ONE OF THE NATIONS WHERE AFTER PRIVATIZATION, THERE WAS NO INCREASE IN TARIFFS. SOME MAY NOT BE HAPPY WITH OUR RATE OF CHANGE. BUT THE KNOWN DIFFICULTIES OF MANAGING CHANGE ARE THE BEST REASON FOR TAMPERING WITH THE HURRICANE OF LIBERALIZATION.

LADIES AND GENTLEMEN,

IN CONCLUSION, I WOULD LIKE TO THANK THE PACIFIC

TELECOMMUNICATIONS COUNCIL AGAIN FOR INVITING ME TO ADDRESS SUCH A HIGH POWERED GATHERING AND I HOPE THAT YOU WILL BE A CATALYST FOR ADVANCEMENT IN THE FIELD OF TELECOMMUNICATIONS NOT ONLY IN THE PACIFIC REGION BUT ALSO GLOBALLY.

THANK YOU.

Pacific Telecommunications Conference
January 1992, Honolulu

Telecommunications Environment in Hong Kong : Regulatory Framework, Market Access and Opportunities

Mr. Dominic S.W. Wong, JP,
Postmaster General and Telecommunications Authority
HONG KONG

Mr. Chairman, Distinguished Delegates, Ladies and Gentlemen,

I am pleased to be with you this morning in the beautiful city of Honolulu. The organisers of the 14th Pacific Telecommunications Conference have asked me to give a presentation on the telecommunications environment in Hong Kong. As the regulator, I am glad to share with you in a few moments some of our experience in the development of telecommunications in Hong Kong, the market opportunities that are currently available and our plans in the next few years.

Background

2. Before I go into this actual topic, let me give you a brief introduction of Hong Kong. We have a small land area of 1,075 square kilometres, and started off as a small fishing village 150 years ago. Because of our strategic location in the Far East, the existence of an excellent natural harbour, the presence of a hard-working labour force, our adaptability to changes and our free trade policy, Hong Kong soon acquired the status of an entrepot in the Orient. With the decline of the entrepot trade, we adapted quickly to this change and turned ourselves into a manufacturing centre of light consumer goods in the 1950's and the 1960's. In the last twenty odd years we continued to diversify and assumed prominence as an important commercial, financial and communications centre in the world. The availability of efficient domestic and international telecommunications systems contributed significantly to our success. The need to maintain a reliable and efficient telecommunications infrastructure is self-evident.

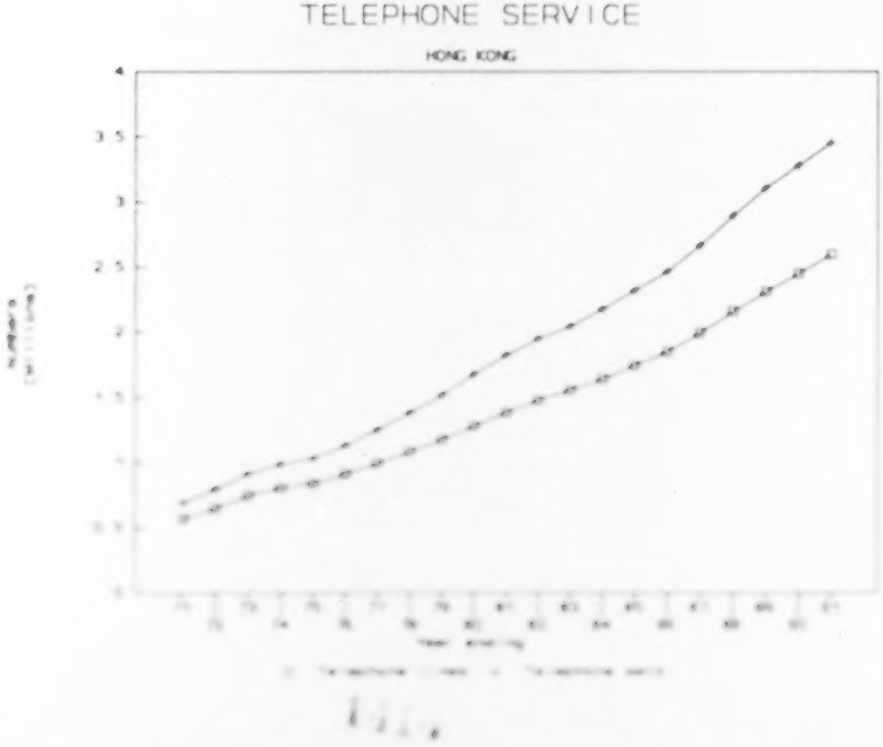
3. In 1990 our total turnover in telecommunications services was US$2 billion (1 billion = 1,000 million). The total export of electronics products was US$15 billion, of which about US$1.5 billion were telecom-

munications equipment. Our GDP per capita was US$12,000. We were the world's tenth largest trading economy, the busiest container port, the fourth busiest air cargo terminal, and the fifth leading financial centre with over 500 foreign banks and deposit taking companies. We had over 300 public listed companies with a market capitalisation of over US$100 billion. That in brief is the prosperous territory of Hong Kong.

Regulatory Environment

4. Such a vibrant market economy needs to be well supported by a good infrastructure. As far as telecommunications is concerned and unlike many countries, the Hong Kong Government is not directly involved in the construction of telecommunications networks or the provision of services in the territory. Instead we encourage private sector investments in public utilities and economic infrastructure, and private companies enjoy much freedom in carrying out their tasks with minimum government intervention. History has shown that our policy has borne fruit.

5. Against this background the first private telephone system was introduced in Hong Kong in 1877, only one year after its invention by Alexander Graham Bell in the United States. The first public telephone service started five years later. Although there were changes in company ownership, subsequent operators continued to operate as a monopoly. By the beginning of the 1980's the wireline telephone network became a comprehensive one and offered an efficient service. At present we have 3.4 million telephones, 2.6 million exchange lines and 130,000 facsimile lines. Over 90% of these lines are digitalised. These figures represent a high penetration rate of 59 telephone sets , 45 exchange lines and 2 facsimile



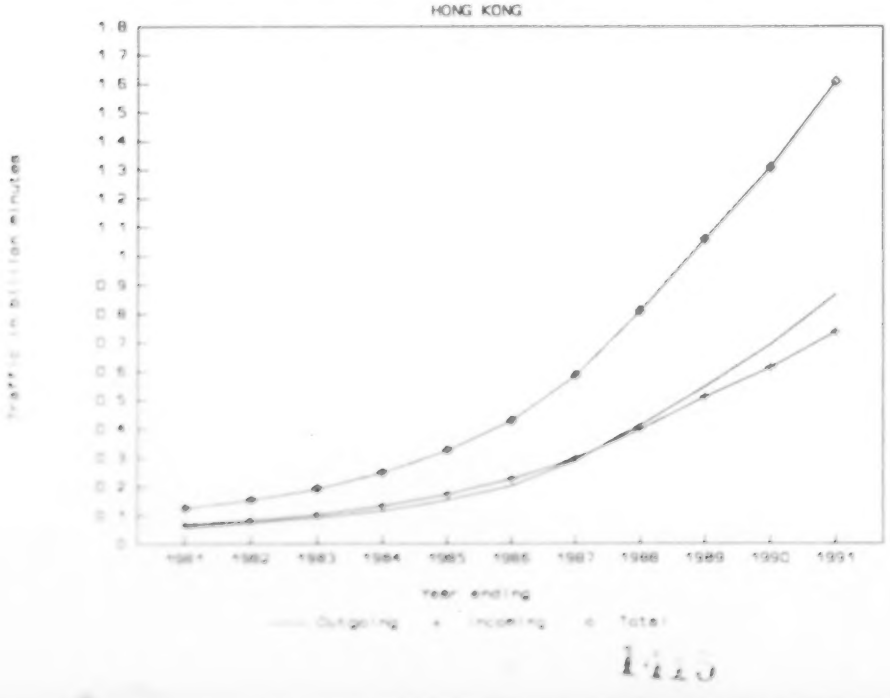
lines per 100 population. The Hong Kong Telephone Company's exclusive franchise for domestic telephone service expires in three and a half years time in June 1995. I know that there are eager eyes watching what the environment will be after that date. A decision will be taken soon.

6. Similar to the domestic telephone service, an exclusive right to supply and operate external telephone and telegraphic services was granted to Cable and Wireless Ltd. The company, recently re-named Hong Kong Telecom International, has been providing a very good service, making heavy capital investments and has succeeded in bringing its network and services to a world renowned standard. International telephone traffic reached 1,375 million minutes in the year ending March 1991, representing four hours for each person in Hong Kong and an increase of about 23% over the previous year. The company's exclusive licence runs another 15 years until 2006.

7. Hong Kong has come a long way under these monopoly arrangements for basic services. This approach has a clear advantage during the start up phase. By the beginning of the 1980's our two exclusive franchise holders together were able to provide comprehensive and efficient networks of domestic telephone and international telecommunications services, with continual updating in technology and improved quality of service to meet basic community needs. Services were widely available at relatively low prices.

8. With the basic telecommunications infrastructure thriving, we were then able in the past decade to embark on gradual deregulation and introduction of competition in other telecommunications services. The outcome is

INTERNATIONAL TELEPHONE TRAFFIC VOLUME



fabulous. Hong Kong benefits from the competitive supply of customer premises equipment (CPE). A wide range of equipment with different countries of origin and at reasonable prices are now available, and a vibrant equipment market has been created.

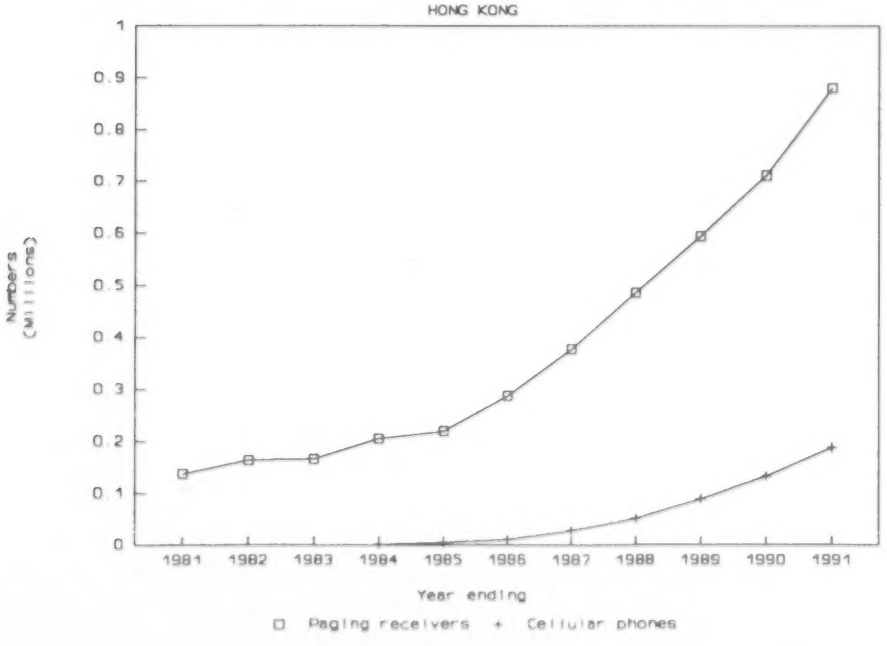
9. The first taste of competition has also created our success story in respect of mobile communications services. Legislation was made, permitting the provision of wireless telephone services and value added services both interconnectable with the public switched telephone network (PSTN) at a charge subject to control by the Government. The licensing regime is deliberately made simple and easy to administer, and centres around technical expertise, financial capability, management structure and quality of service.

10. Within this environment we have licensed four cellular telephone systems : one using the US AMPS and three using the European ETACS standards. At present the number of cellular phone users stands at 180,000, representing a penetration rate of 3% population. I am told that Hong Kong has the highest proportion of hand held portable phones in any sizable cellular phone market in the world.

11. We have also a very competitive radio paging market with over 30 operating companies. There are over 860,000 users, representing a penetration rate of 15% of population. Again this is the highest in the world.

12. Competition has given consumers wide choice, not just of operators but also of equipment. For example, many brands of cellular phones of varying capabilities are available. There are radio pagers that can display messages in English and Chinese; pagers in the size of a credit

PUBLIC RADIOCOMMUNICATION SERVICES



card or a wrist watch; paging services that allow private telephone lines to be answered by paging operators who act as secretaries 24 hours a day. More importantly, services are now available at reasonable prices. For example, the air-time charges are about US$25 a month for unlimited calls for radio paging services and about US$0.20 per minute for cellular phone services.

Overall Objective

13. As the Telecommunications Authority of Hong Kong, my objective is to foster a favourable environment for the growth of an adequate telecommunications infrastructure and to establish a stable regulatory framework for the provision of telecommunications services, whether they are provided on an exclusive or competitive basis. This, in turn, will bring benefits to users in the form of improvements in technology and efficiency.

Recent Developments

14. In the past year we continued to support the introduction of new and innovative services on a competitive basis, and to ensure that players in the field could compete on a fair and equitable basis. There were three important developments.

15. First, in January last year we reached an arrangement with the United States to introduce international value added network services (IVANS) using international private leased circuits between Hong Kong and the United States. Similar arrangements were made with the United Kingdom last June and with Japan last month. Services include enhanced facsimile and all forms of enhanced data communications. IVANS operators can therefore use IPLC's at the normal flat-rate tariffs, bringing corresponding benefits to consumers. Our experience has had positive results. We plan to make a similar arrangement with Australia soon and with other countries having similar interest.

16. Secondly, in March last year licences were granted to four operators to set up and operate territory-wide Telepoint Services using the Second Generation Cordless Telephone (CT2) technology. The licensees include major telecommunications players from the United States, the United Kingdom, Australia and Hong Kong. Construction of Telepoint networks is well underway, and we expect to have initial service within three months from now.

17. Thirdly, a licence was issued two months ago to a consortium (comprising the United States, Singapore and Hong Kong telecommunications operators) to construct and provide an international radio paging network and service using the frequency 931.9375 MHz. The service will be available in the middle of this year, and will initially cover the United States, Canada, Singapore and Hong Kong. It is expected to extend to other places in future. As there is only one common frequency designated at present, the network provider is required under the licence to make available the spare air-time for resale by other radio paging companies which therefore can also provide international radio paging services. Hence the market will remain competitive.

Market Access and Opportunities

18. I have spoken at length about the development of telecommunications services in Hong Kong and our regulatory policies. What about market access and opportunities?

19. In Hong Kong we have an open market economy. We practise and fully support the spirit of free trade without barriers, both in goods and in services. Being a full member of the GATT, we are fully committed to the GATT principles of allowing greater freedom for market access and the use of public telecommunications networks and services.

20. In the field of telecommunications in particular, we have a regulatory environment which permits market access to all forms competitive services. We adopt an open door policy for investments : thus there is no restriction on foreign ownership, and no requirement for local manufacturing or technology transfer. As I said earlier on, the licensing regime is deliberately made simple. Competitive services thriving under such environment include radio paging, trunk radio systems, cellular phones, international and local value added services, and CT2 Telepoints in the near future.

21. On the equipment supply side, you have heard that we have totally deregulated customer premises equipment and its connection into the public switched telephone network and other public telecommunications networks, subject of course to network compatibility. Recently we have retrieved the control of type approval and testing of equipment from the telephone network operator back to the Telecommunications Authority (which is myself). We believe that this will improve the transparency of the process and ensure fairness. Under the new procedure we can also accept type testing conducted by any accredited testing laboratory in Hong Kong or overseas. We will also consider conferring accreditation on manufacturers themselves if they have the relevant testing facilities and expertise to test the equipment to our specifications. Needless to say, our specifications are not onerous and are simply minimum requirements to ensure network integrity and compatibility. (A booklet on the new procedure is available.)

22. As regards IVANS and domestic value added services, the same simple licensing procedure applies. The criteria are published in a guidance note for applicants, and are merely requirements to ensure technical competence, service quality, fair competition and protection of consumer interests. A Public Non-Exclusive Telecommunications Service (PNETS) Licence can be issued within a fortnight.

Future Opportunities

23. What about the future? The telecommunications investment opportunities in Hong Kong are by no means finite. Some of you may recall that two years ago we licensed a company to provide a territory-wide cable television service in Hong Kong. Regrettably, owing to problems within the company it decided to withdraw from the project. We are still keen to have cable or subscription television in Hong Kong. We plan to invite applications again within six months. Even now, there are keen candidates

looming around the horizon, despite the availability of a wide range of satellite television programmes in Hong Kong as a result of our open sky policy. The successful bidder may, if it wishes, also apply to the Telecommunications Authority to operate telecommunications services.

24. As regards public cellular phone services, the existing networks (based on the analogue technology) will become saturated in about a year's time. We in Hong Kong have been monitoring the development of digital technology in Europe and the United States, and are satisfied that both the pan-European GSM standard and the United States Digital AMPS standard should be introduced in Hong Kong as from 1993. Naturally we have to bear in mind the contribution and achievement of the three existing operators on the one hand, and the desirability of encouraging further competition by admitting new players on the other. Licensing arrangements should be finalised within a few weeks, and I expect to make a public announcement on this subject very soon.

25. As regards the basic telecommunications services, the exclusive licence granted to Hong Kong Telecom International for the provision of public external basic telecommunications services will not expire until the year 2006. It is therefore too early to consider what should be done after that date.

26. The exclusive franchise for the operation of domestic telephone service will expire in June 1995. We are now undertaking a policy review to determine what the regulatory environment should be after that date. This is an exciting subject. We will draw on our own experience in recent years and take careful note of developments in other advanced economies. I believe that we will soon be able to make an announcement of our future policy - one which I hope will be encouraging.

Conclusion

27. Let me now sum up for you. In Hong Kong we adopt a liberal policy on the supply of telecommunications equipment and the provision of telecommunications services, except for the basic services where one exclusive franchise is due to expire in 3.5 years time and the other exclusive licence will remain for some time. We have no foreign ownership restrictions. We welcome foreign investments. As described earlier, there are ample opportunities opening up in the field of telecommunications in the near future. Hong Kong has the advantages of administrative efficiency, political stability and economic prosperity. As the Telecommunications Authority of Hong Kong, I welcome new business initiatives and participation as these will ensure a continuing vibrant market in Hong Kong, with the latest technology for end users and a wide variety of choice for consumers.

Thank you.